

SCIENTIFIC AMERICAN

MAY 1928



Thirty-five Cents a Copy



NEW "EYES" FOR SEALING FLEETS

THE EARTH AS A MAGNET

By W. F. G. SWANN

RATTLESNAKE FARMING



**Partial List of
Newspapers Dis-
tributed by
International
Trucks**

New York Journal
New York News
New York Sun
New York Telegram
Wall Street News
Wall Street Journal
Chicago Tribune
Atlanta Georgian
Baltimore News
Bethlehem Times
Boston Globe
Brooklyn Times
Burlington Free Press
Cincinnati Enquirer
Columbus Dispatch
Columbia State
Council Bluffs
Nonpareil
Davenport Democrat
Davenport Times
Decatur Review
Deseret News
Detroit News
Duluth News Tribune
Elizabeth Journal
E. St. Louis Journal
Harrisburg Telegraph
Harrisburg
Times-Tribune
Houston
Post Dispatch
Indianapolis Times
Indianapolis Star
Kansas City
Journal-Post
Memphis
Commercial Appeal
Minneapolis Tribune
Moline Dispatch
Nashville Banner
Newark Evening
News
New Orleans
Item-Tribune
Philadelphia Record
Peoria Evening Star
Peoria Int. Transcript
Pittsburgh Post
Gazette
Pittsburgh Sun
Telegraph
Quincy Herald-Whig
Regina Leader
Rock Island Argus
Saskatoon Star
Scranton Times
Sioux City Journal
Sioux City Tribune
Springfield Illinois
State Journal
St. Cloud Times
St. Joseph News-Press
Tampa Telegraph
Tampa Tribune
Toledo Blade

A Straight Tip on a Good Investment

Day-in, day-out, and every day of the year, newspapers must get to their readers *hot off the press*. News can never be slow or it isn't news.

And so, from one end of this country to the other, you'll find leading newspapers depending on International Trucks to take up the job where the presses leave off. And what a job these Internationals do! Hard, grueling service . . . through mud, slush, snow, rain . . . any hour of the day or night, in all kinds of weather, over all

kinds of roads, they deliver the news.

At the left is a partial list of papers that use International Trucks. The hauling demands of the large metropolitan dailies are strenuous in the extreme and Internationals are used exclusively by some of the largest in the country.

Take a straight tip from the newspapers that know these trucks first hand. Put Internationals to work in your own business and you will find them the best truck investment you ever made.

The International line includes the Special Delivery for loads up to $\frac{3}{4}$ -ton; 4 and 6-cylinder Speed Trucks of 1 $\frac{1}{4}$, 1 $\frac{1}{2}$ and 2-ton sizes; Heavy-Duty Trucks ranging from 2 $\frac{1}{2}$ -ton to 5-ton sizes; Motor Coaches; and McCormick-Deering Industrial Tractors. Sold and Serviced by 160 Company-owned Branches in the United States and Canada and dealers everywhere.

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OF AMERICA
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INTERNATIONAL TRUCKS





Giant, freight-hauling locomotive with auxiliary locomotive underneath the tender equipped with SKF Spherical Journal Bearings on all twelve wheels.

The Little Giant that Works Beneath the Tender—on **SKF**—the Highest Priced Bearing in the World ~ ~ ~

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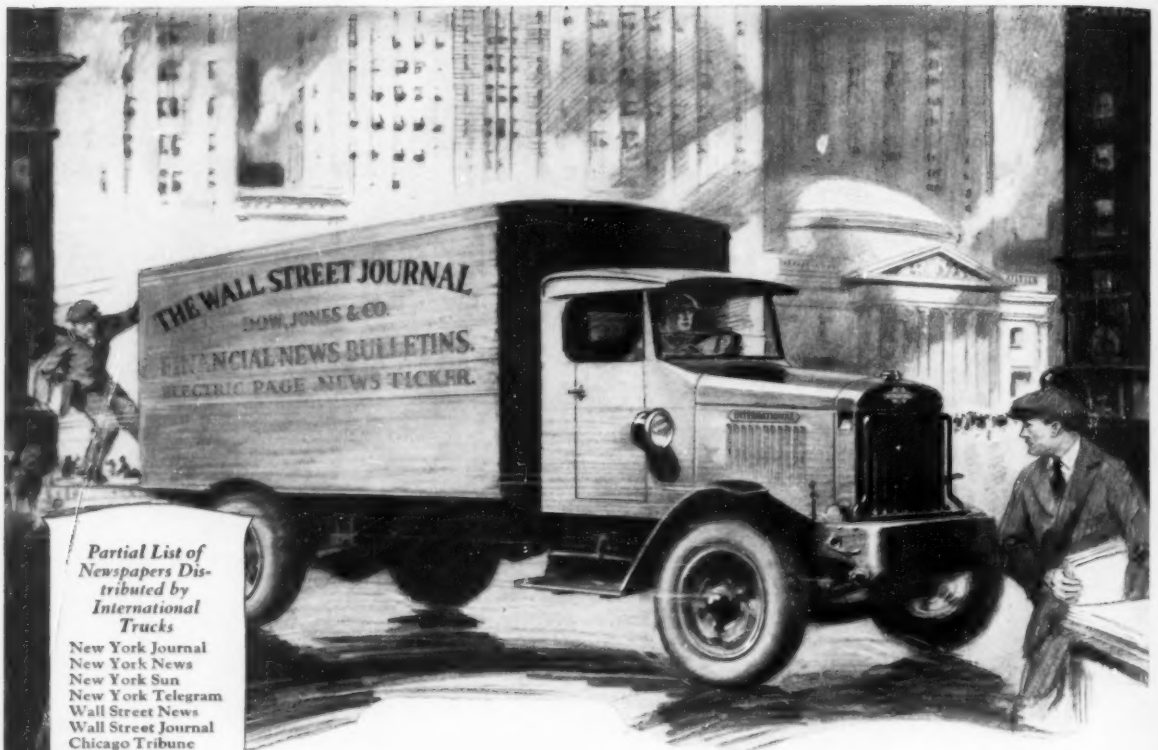
SKF

Ball and Roller Bearings



2012

Nothing Is Apt to Cost So Much as a Bearing that Cost So Little



**Partial List of
Newspapers Dis-
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Wall Street News
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Chicago Tribune
Atlanta Georgian
Baltimore News
Bethlehem Times
Boston Globe
Brooklyn Times
Burlington Free Press
Cincinnati Enquirer
Columbus Dispatch
Columbia State
Council Bluffs
Nonpareil
Davenport Democrat
Davenport Times
Decatur Review
Deseret News
Detroit News
Duluth News-Tribune
Elizabeth Journal
E. St. Louis Journal
Harrisburg Telegraph
Harrisburg
Times-Tribune
Houston
Post Dispatch
Indianapolis Times
Indianapolis Star
Kansas City
Journal-Post
Memphis
Commercial Appeal
Minneapolis Tribune
Moline Dispatch
Nashville Banner
Newark Evening
News
New Orleans
Item-Tribune
Philadelphia Record
Peoria Evening Star
Peoria Jnl. Transcript
Pittsburgh Post
Gazette
Pittsburgh Sun
Telegraph
Quincy Herald-Whig
Regina Leader
Rock Island Argus
Saskatoon Star
Scranton Times
Sioux City Journal
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SCIENTIFIC AMERICAN

24 WEST 40th STREET

May 1928

Edited by ORSON D. MUNN

NEW YORK CITY

Eighty-fourth Year

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COVER

Out of sight of the distant sealing fleet, the seals playfully disport themselves on ice floes, hidden by mountainous icebergs. Without the aid of the scouting airplane, they would, perhaps, never be located, and the ships would go home empty-handed. Read the interesting story, beginning on page 409, of the adoption of the airplane to the needs of a great industry.

Settle the Car Questions

Timken developed the anti friction bearing with tapered construction. Timken sponsored the exclusive feature of *POSITIVELY ALIGNED ROLLS*. And Timken operates its own electric furnaces to assure the most wear-resistant bearing steel ever known.

But these technicalities need be no concern of yours. You *settle* big technical questions simply by making sure of Timken Tapered Roller Bearings in any car, truck or bus you buy. Then you are sure of utmost protection not only against friction, but against side-thrust, shock, weight, torque and speed. Timkens give you this complete wear-protection, and greater simplicity, compactness and accessibility—in differentials, pinion or worm drives, transmissions, rear wheels, front wheels, steering pivots and fans.

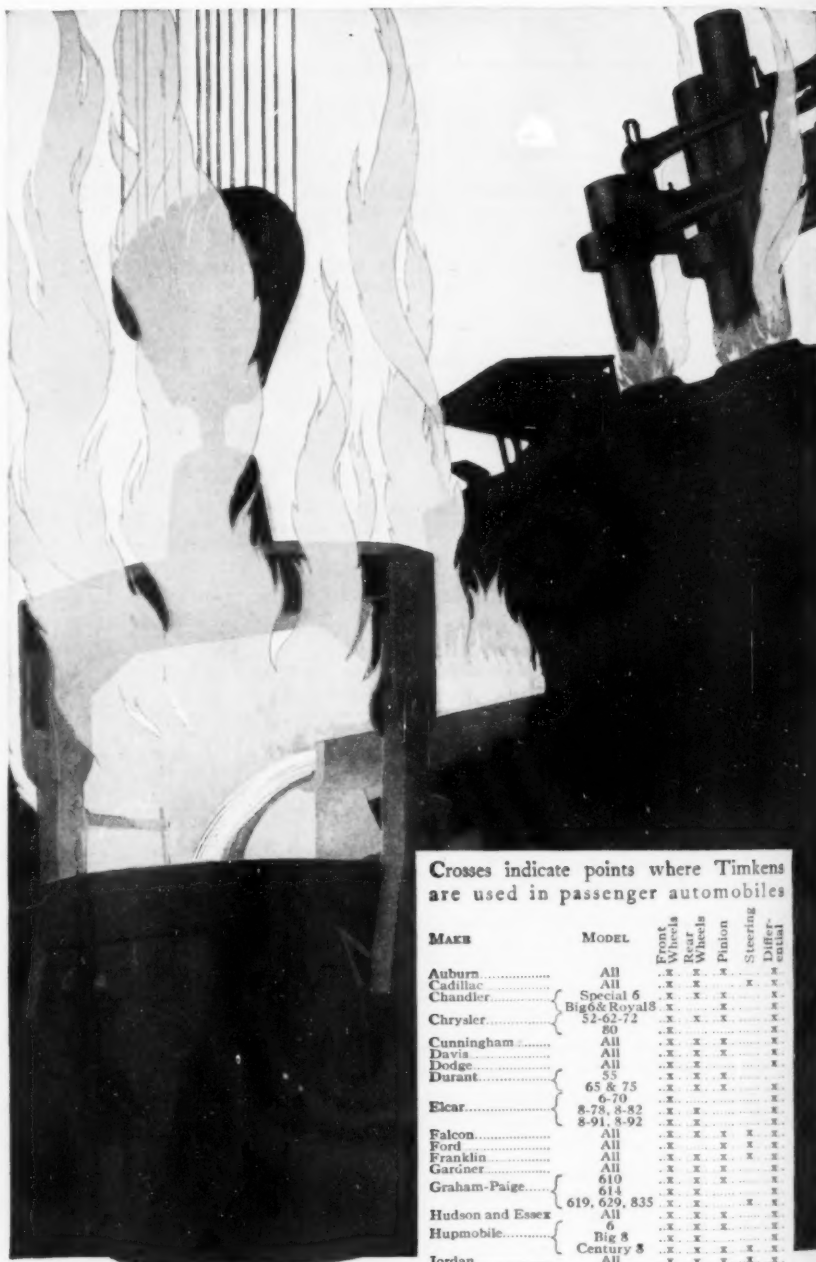
Remember, the bearings have the final responsibility for carrying the motion. The bearings are vital. Buy Timken-equipped.

THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

TIMKEN

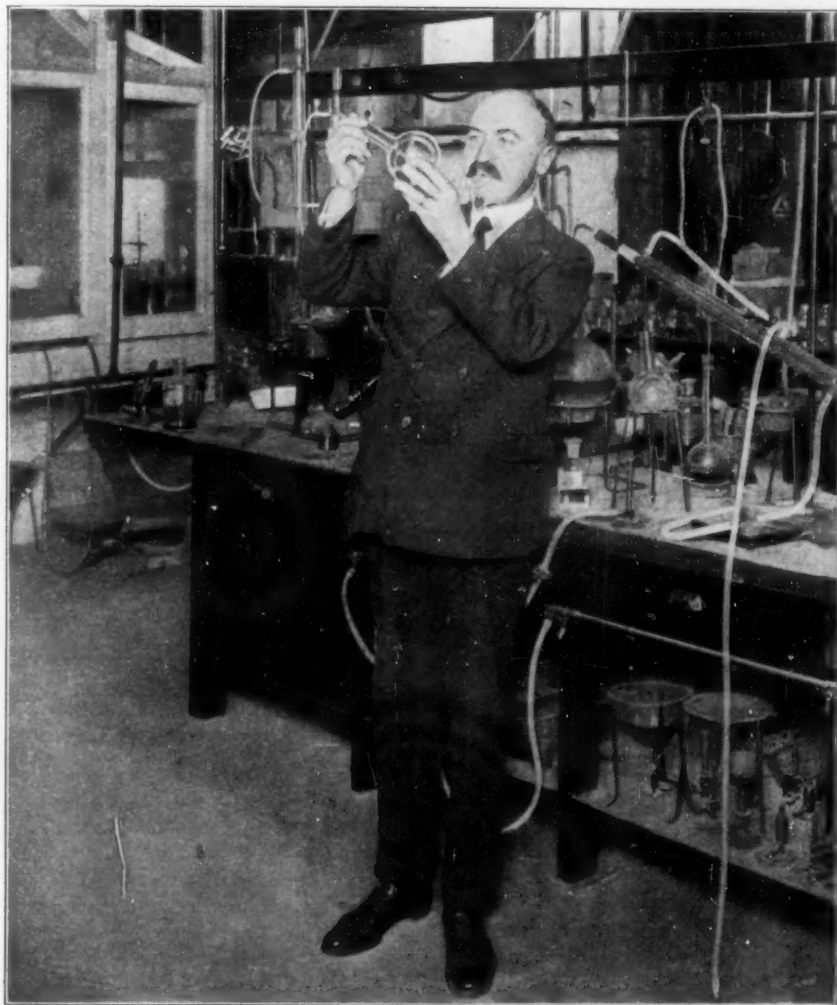
Tapered
ROLLER BEARINGS

In the Timken steel mill, control of every quality factor has been brought to an unparalleled degree of accuracy. Here one of the battery of Timken electric furnaces is discharging liquid steel at a temperature of 2800° F.



Crosses indicate points where Timkens are used in passenger automobiles

MAKE	MODEL	Front Axle	Rear Axle	Pinion	Steering	Differential
Auburn	All	X	X	X	X	X
Cadillac	All	X	X	X	X	X
Chandler	Special 6	X	X	X	X	X
Chrysler	Big 6 & Royal 8	X	X	X	X	X
Cunningham	52-62-72	X	X	X	X	X
Davis	80	X	X	X	X	X
Dodge	All	X	X	X	X	X
Durant	55	X	X	X	X	X
Elcar	65 & 75	X	X	X	X	X
Falcon	6-70	X	X	X	X	X
Ford	8-78, 8-82	X	X	X	X	X
Franklin	8-91, 8-92	X	X	X	X	X
Gardner	All	X	X	X	X	X
Graham-Paige	610	X	X	X	X	X
Hudson and Essex	614	X	X	X	X	X
Hupmobile	619, 629, 835	X	X	X	X	X
Jordan	All	X	X	X	X	X
Kissel	Big 8	X	X	X	X	X
LaSalle	Century 5	X	X	X	X	X
Lincoln	All	X	X	X	X	X
Locomobile	All	X	X	X	X	X
Marmou	Jr 8	X	X	X	X	X
McFarlan	68	X	X	X	X	X
Moon	78	X	X	X	X	X
Nash	All	X	X	X	X	X
Peerless	Sol 6	X	X	X	X	X
Pierce-Arrow	6 and 8	X	X	X	X	X
Reo	8-69	X	X	X	X	X
Star	6-91, 6-60 and 6-80	X	X	X	X	X
Stearns-Knight	81	X	X	X	X	X
Studebaker and Erskine	36	X	X	X	X	X
Stutz	Flying Cloud	X	X	X	X	X
Velie	Wolverine	X	X	X	X	X
Willis	All	X	X	X	X	X
Overland	All	X	X	X	X	X
	Whippet 4	X	X	X	X	X
	Whippet 6	X	X	X	X	X
	36	X	X	X	X	X
	66-A	X	X	X	X	X
	70-A	X	X	X	X	X



L. H. Baekeland

BAKELITE, familiar to everyone, derives its name from its original inventor, Dr. Leo Hendrik Baekeland, who is also the inventor of Velox photographic paper. Among chemists and leaders of industry, Dr. Baekeland is recognized as a peer of the ablest. Born in Belgium, where he received many honors from scientific institutions, he came, when 26 years of age, to America and engaged in chemical research work. Years later he invented the synthetic substance bakelite resin, made from carbolic acid and formaldehyde. Replacing hard rubber and other substances, it is used for electrical

and industrial purposes now far too numerous to mention. Dr. Baekeland's honors in the world of science are many: The notable Nichols Medal of the American Chemical Society was awarded him in 1909; the Willard Gibbs Medal in 1913. The John Scott Medal of the famous Franklin Institute has also been presented to him for his able research. He is past-president of the Inventor's Guild, the American Institute of Chemical Engineers, and the great American Chemical Society. Many patents have been given him in the fields of organic chemistry, electrical insulation and synthetic chemical products.

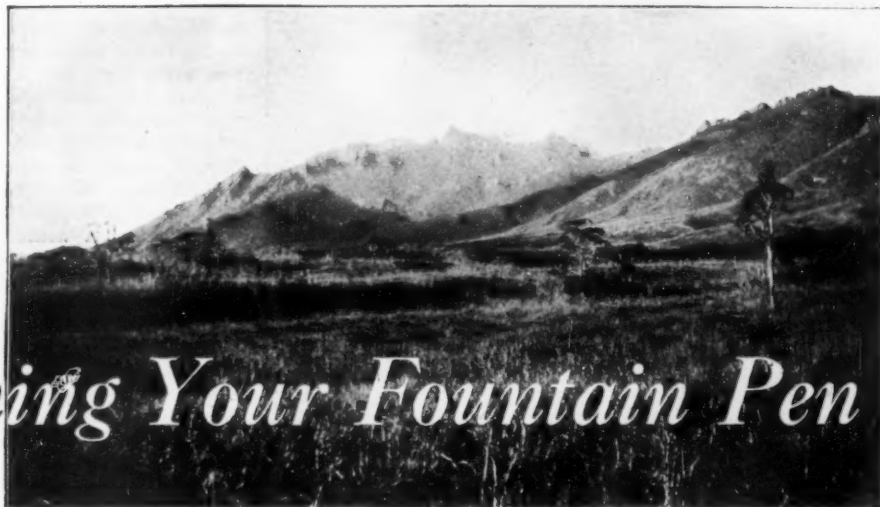


By Burton Holmes, from Ewing Galloway

Just Below the Arctic Circle

THIRTY years ago the world was stirred by the announcement of the discovery of gold in the Yukon River district of western Canada and in Alaska. Adventurers of many lands representing a great variety of types abandoned their normal pursuits and rushed to the land that promised a fortune for the taking. "The Klondike" became a magic password and to many it meant, so they supposed, the end of the rainbow. Through the trackless wastes of the north, these hopeful gold-seekers went with dog teams

and afoot, through snow and winter weather that rapidly weeded out the weak and left them, frozen and helpless, at the mercy of wolves. The hardy ones went on, survived temperatures of 40 degrees below zero, and finally staked out their claims here and there throughout the district. Settlements sprang up, time passed, and transportation was modernized. The photograph shows one of the most picturesque mountain bridges in the world, now spanning White Pass on the desolate, heart-breaking trail to the Yukon.



Mining Your Fountain Pen Tips

Dramatic Rush to Osmiridium Fields of Tasmania for Precious Metal Once a Nuisance to Gold Miners

By P. ORMSBY LENNON

Fellow of the Royal Colonial Institute, London

IN the early days, Tasmanian prospectors operating in the northwest of the island, found a rich belt of country which yielded a variety of mineral substances of more or less commercial value. Prospectors for gold found, in panning off, an unknown metal of tin-white color, which weighed much more than gold itself. It was regarded as a nuisance, as it was found difficult to separate from gold, and because a penalty of seven shillings, six pence* an ounce was imposed by the mint for its non-removal.

It is related by old hands how they filled oatmeal bags or pickle-bottles with this apparently useless metal, and how they either gave it away as a curio, or else, finding it useless lumber, pitched it out of their camps. Little did they think that a fortune was within their grasp.

IN some localities this metal was so abundant that steps were taken to have it scientifically identified. It eventually transpired that they found this metal to be osmiridium. At first, the price obtained was only 25 shillings an ounce, but in 1910 it rose to four pounds, 10 shillings. From that time its value yearly increased, until in 1921 it reached the surprising price of 42 pounds, 10 shillings, an ounce.

Osmiridium is one of the world's rare

metals; and although it has many uses, comparatively few people are aware of its existence. This metal is a native alloy, closely allied to platinum, and consists mainly of iridium and osmium, together with smaller percentages of rhodium, ruthenium, and palladium. It is white in color, very heavy, and, as mined, somewhat resembles steel filings. At present the main sources of production are Tasmania in Australia, and South Africa. In the latter country it is obtained as a by-product of

commercial uses has been extended greatly during recent years. Each of its component metals are used for various industrial purposes, while the mineral itself is used in the arts without disassociation of the metals. Iridium is employed in the manufacture of acid-resisting dishes, basins and crucibles, and in the production of bars for standard weights and measures. It is also used in electrolytic work, photography, and for enameling purposes by jewelers. Surgical needles and jewelers' drills to a limited extent are also made from the metal.

Osmium has been extensively used as a stain in physiology and microscopy. Because of its high melting point, it is often employed for the preparation of the filaments of incandescent lamps.

Osmic acid and osmic chloride, both highly poisonous gases, are derived from osmium and have been extensively used in warfare. Osmiridium's other component metals are used in the manufacture of electric filaments, acid-resistant crucibles, jewelry work, and in certain kinds

of dental alloys. Osmiridium itself is used almost exclusively for the tipping of gold-nibbed fountain pens; and it is said that so far no suitable substitute has been found to take its place. Since it is unoxidizable and non-magnetic, it is



TREKKING HOPEFULLY ONWARD

Group of would-be prospectors "humping their swags"—heavy equipment—through the bush to the Adams River district in Tasmania, where they hope to mine fortunes

platinum ore residues, but in Tasmania it is found in a "free" or alluvial state in the beds of gravelly wash and detrital matter near the huge outcrops of serpentine rock, in which it is supposed to have had its origin.

The application of osmiridium to

*Due to varying rates of exchange, we have retained the English monetary figures throughout.—The Editor.



AN EARLY CAMP

The settlement later grew into a regular town after the government cut a track through

sometimes used for watch bearings and is also employed by manufacturers in secret processes, the nature of which are unknown.

Once the gold-miners became acquainted with the value of this metal, the known Tasmanian fields soon were depleted, and it was not until 1925 that a new one was discovered by a party of prospectors operating in the wild and almost unknown Adams River district lying out to the west of the island.

About the middle of that year a stampede out to the new discovery took place, and culminated in being the biggest mining rush in Australia for many years. Reports gained currency that fabulous fortunes were being made by miners there, and in consequence, numbers of men threw up their jobs to venture forth to this reputed El Dorado. Among the throng of fortune hunters were to be found miners, prospectors, trappers, ex-politicians, soldiers, sailors, professional men, clerks, shop assistants, ministers of religion—in fact men from practically every known walk of life. It was just as if the old Australian gold-digging days were beginning again.

THE Adams River field is situated about 30 miles from Fitzgerald, the little timber-milling outpost at the Derwent Valley rail-head. The route there lay through dense forests and swamps, and over high mountains. It was possible to take pack-horses only part of the way in the beginning, as the country was so rough and scrubby that they could not get through to the field. Would-be diggers, therefore, had to "hump their swags" for the rest of the way. Since these frequently weighed between 75 and 100 pounds, the rest of the journey was slow and arduous work.

There was no established track be-



BAD MAN?

Not quite. Just a new-comer who has not as yet discarded his unnecessary artillery



CAMP ON THE RIVER BANK

Tents, as used at first, were rapidly replaced by log or paling huts similar to the one shown here. Far from civilization, the men lived here on the simplest of foods. This photograph shows clearly the jungle-like growths and rank vegetation that make the section scarcely livable

yond a sort of path which had been beaten down by the first rushers, and owing to the heavy traffic over this, it was knee-deep, and often waist-deep, in mud. In addition, it was littered with the fallen trunks of huge trees, and a man cumbered with a heavy "swag" found it no easy matter to scale these.

The rush took place in the middle of the antipodean winter, and the prevailing weather then was the worst that had been experienced for many years. Torrential rains fell nearly all the time, varied by severe snowstorms and blizzards which sometimes lasted for days on end; while the rivers and creeks were generally in a flooded and dangerous condition. The early rushers had to cross the treacherous Florentine River by means of a narrow myrtle log and a handwire stretched from bank to bank. This log was often three feet under water, and the wonder is that men were not swept off it by the rapid current and drowned. But fortune generally seems to favor the brave, for there were no fatalities.

MANY of the rushers were unable to reach the field and had to turn back to civilization. Numbers of men were quite unused to the ways of the bush, not even having a rudimentary knowledge of the art of camping out, and in consequence, suffered great hardships. It was a common sight to see would-be diggers lying by the side of the track, overcome by exhaustion. Some of them had to be carried back.

Owing to the difficulties of transport, the prices of provisions on the field were higher than has been known in any other Australian mining community. A four-pound loaf of bread cost six shillings, six pence; while a 25 pound bag of flour cost nearly four

pounds. One miner purchased three pounds worth of potatoes and onions at the rail-head, and the freight of these to the field cost him over 28 pounds! As is usual in such rushes, the "sly-groggers" were well to the fore, and in the height of the boom days they obtained as much as 10 pounds for a bottle of rum, which was mainly composed of methylated spirits.

In the beginning, all the diggers lived in tents; but as time went on, these gave place to the more picturesque log and paling huts. Conditions of living were very poor at first; bacon, damper, and "embalmed beef" being the staple articles of diet. However, all this has changed, as the government cut a track through to the field, which had the effect of causing a prosperous township to spring up, and assuring plentiful supplies.

AT the height of the boom the place was strongly reminiscent of a wild western mining camp in the "movies." Everybody packed a gun. From occasional wild rumors that filtered through to Hobart, the picturesque capital of Tasmania, one was led to believe that Adams River was the haunt of professional "bad men." As a result, nobody ever thought of venturing out to the field without a revolver and a large supply of ammunition.

At one time it was not possible to purchase a weapon in Hobart. All the small arms dating from the bush-ranging days had been bought up. The gunsmiths and pawnbrokers did a roaring trade—they said they never before had had such a demand for weapons. It was the same with picks, shovels, prospecting dishes, and tents; they could not be obtained for love nor money. Finding that there was no real necessity for these weapons of defense, the diggers expended their



SETTLING BOX

Osmiridium-bearing earth is thrown into the sluice box, is thoroughly beaten, and the mud then flows off in the water, leaving the heavy precious metal on the bottom of the box. Other methods are essentially the same as this, for a mud slush must be obtained before the metal separates



CAREFREE ADVENTURERS

Men from many walks of life made the rush to the field. Here are two typical ones. It is hard to believe that these, looking like "movie" actors in makeup, may have been clerks, storekeepers, or professional men

ammunition in the air, or at target practice. Every other evening, volleys of shots would ring out in all directions, and many times strangers were led to believe that civil war had broken out among the diggers.

The mother rock of osmiridium is supposed to be serpentine, which derives its name from its snaky, greenish, mottled appearance. The metal has never yet been found in reef formation, so its occurrence is a perennial source of mystery to mineralogists. It is, however, always found in the vicinity of serpentine outcrops, so we are led to conclude that it was originally shed by this rock. It is in the creeks, on the hillsides, and even on the plateaux of such serpentine country that the miner gets his osmiridium.

SERPENTINE is what is known as an altered eruptive rock, and there are many theories current as to its origin. It is generally believed, however, that the penetration of acid and other vapors, and of heated water, decomposes many of the crystalline minerals, displacing some of their constituents, and replacing them by waters of constitution and other compounds; thus rocks containing olivine, peridotite, and bronzite are converted into serpentine. Serpentinization commences in the minute fissures of olivine, et cetera, and continues until the whole is converted into a mass of fine fibrous material.

For the most part, osmiridium is found in a capricious, erratic fashion. There is no knowing where it may occur. Miners working on claims adjacent to a man recovering ounces daily, cannot even find enough to cover their living expenses. On the Adams River field, mining seems to be more a matter of good luck than of sound judgment and hard work.



ON A LARGE SCALE

The owners of this claim, more fortunate than others in having better "pay dirt," used this method of pulverizing the soil and mixing with water. Horses, however, were very rare at the first

Osmiridium is known to occur in two distinct varieties, both of which are found in Tasmania. The variety known as nevyanskite is the familiar tin-white substance with a bright



"PUGGY"

Foot power is used to pulverize clayey mud and separate the soil particles before sluicing

metallic luster. The other sort is known as siserskite, which is of a much duller luster, and is steel-gray, with a bluish tint. The former kind of osmiridium is obtained at Adams River, and contains over 40 percent of iridium. Siserskite contains less of this metal, and more of osmium—therefore it is the less valuable of the two.

THE methods employed in mining osmiridium are generally of a very primitive character, and vary according to the class of country to be worked. After ground showing payable "prospects" of the metal has been found—nothing less than 15 or 20 "colors" or specks to the dish is considered to be payable—the miner pegs out his claim of 50 square yards. When this has been cleared of all obstructions in the nature of timber and scrub, work is commenced in earnest.

If there is enough running water, a tail race is cut, and a sluice box made of slabs of rough-hewn timber is set in position. This box is a sort of trough open at each end so as to let the water run through. The earth containing prospects of the mineral is shovelled into this and worked up and down with an eight or ten pronged sluice fork, so as to let all the mud run off.

All detrital matter, such as gravel, et cetera, is also removed. The osmiridium, being heavy, sinks to the bottom of the box, together with the metallic black sand (chromite) always found with it. At the end of a day, or a working shift, this is scraped up and washed off in dishes.

This washing process can only be learned after much practice. The dish is grasped by both hands, tilted in a pool of water at an angle of about 45 degrees, and is given a peculiar oscillating twirl, so as to gradually get rid of the unwanted chromite. When all

this has been washed off, the osmiridium—if any—remains at the bottom of the dish.

When the ground contains much clay or is "puggy" as the miners call it, it requires different treatment in the initial stages. It has to be trampled up in wooden troughs and beaten into a sort of liquid slush before it can be put in the sluice box, as otherwise the osmiridium could not be separated from the cheesy mud. This process is known as "puddling."

There are other ways of mining osmiridium—ground sluicing, hopping, and cradling, being some of the methods in vogue. The broad principles of each, however, are much the same as those of the first mentioned method, the one used being dependent on the kind and quantity of "paydirt" to be treated, and on the volume of water available.

Although there were no large fortunes made from the field, several men



SLUICING

The sluice box was a simple trough, open at both ends, for washing out mud—slush

did extremely well. Quite a few miners found over 10 ounces of metal a day for periods extending over months. At the beginning of the rush, the price for osmiridium was nearly 33 pounds an ounce, and handsomely repaid miners with good claims. Many claims paid their possessors from 40 pounds to 200 pounds a week; but on the other hand, hundreds of men could not obtain enough to provide them with a living. Because of the heavy supplies of osmiridium coming from this field, the market demand slackened considerably, and the price is now less than half of that paid in the boom days.

The Adams River field is rapidly on the decline, and production has fallen off considerably. The country in which it lies is in an exceedingly rich mineral belt, and as the area is gradually opened up, it is not improbable that further important discoveries

of commercial metals will be found.

Since the country is so densely forested, prospecting work is attended with many difficulties and hardships. In some parts it is not possible to traverse more than a mile a day because of the thick underbrush. In addition, the rivers are dangerous, and due to the mountainous nature of the district, are liable to flood at a moment's notice, thus cutting pioneers off from supplies and civilization. The country is valueless for stock, owing to its wet and marshy condition, but the forests of eucalypti and other valuable woods are still untapped, and are worth untold millions of pounds.

LIFE at Adams River is representative of all other places in this rough section of the island. Winter conditions out there are almost indescribable. The few trails are seldom less than knee-deep, and often waist-deep, in mud; while the surrounding scrub is frequently dripping with moisture, and it is impossible to go through this without getting soaked through.

In summer, the heat is almost semi-tropical, and work in the forests and steaming button-grass marshes is both trying and difficult. At Adams River snakes are abundant, and often pay unwanted visits to diggers' tents. After a few days of fine weather the scrub becomes tinder-dry, and bush-fires sweep through this with the speed of a galloping horse.

In the fires which ravaged Adams



PANNING

Eliminating the undesirable chromite from the settlings after the mud is first removed

River recently, many men had all their belongings destroyed by the flames, and in some cases narrowly escaped with their lives.

The fires, however, had one good effect, for they cleared much of the heavy forest, making it much easier for the miners to enlarge the sweep of their prospecting operations.



PROFESSOR BREASTED IN HIS STUDY AT THE ORIENTAL INSTITUTE

Among his many writings on ancient civilizations, none is more colorful and dramatic than his latest work "The Conquest of Civiliza-

tion," which the editor has read. This is Part I of "The Human Adventure," a new, popular, historian's "outline" of world history

Recovering New History

American Funds Are Now Being Employed to Reveal Vast New Reservoirs of Hitherto Untouched Archeological and Historical Fact in the Orient

By JAMES HENRY BREASTED, Ph.D.; D. Litt.

Director, the Oriental Institute

Professor of Egyptology and Oriental History, University of Chicago

Member, National Academy of Sciences; American Philosophical Society

WE now know that Egyptian civilization was preceded by several hundred thousand years of Stone Age savagery. Where now stretch the desolate wastes of the Sahara there were vast, well-watered forests, and the Stone Age hunters ranged across all north Africa and deep into Asia.

The desert heights which now look down upon the desolate valley cemetery of the pharaohs and the tomb of Tutenkhamon were once occupied by the flint workshops of the north African Stone Age hunters. The fragments from their flint chipping cover the surface for a long stretch above the cemetery of the pharaohs. The stone weapons and implements of these prehistoric men are likewise found widely scattered and still lying on the surface from Algiers to Egypt and the Red Sea.

These hunters must eventually have descended into the Nile Valley as its once high waters sank. Their stone implements are still found lying on the ancient Nile terraces, abandoned at a

time long before the great river had begun to deposit the 30 feet or more of black soil which has since accumulated to form the present fertile floor of the Nile Valley. The traces which they left at lower levels in the Nile trough have since been covered by the rising accumulations of soil.

Throughout all these prehistoric epochs north Africa was connected with Europe by land bridges at Gibraltar and through Sicily, permitting these prehistoric hunters to pass at will from Africa to Europe. They have likewise left their traces in western Asia, in Sinai, Palestine, Syria, and the Euphrates Valley. No systematic collection and survey of these evidences in north Africa and western Asia has ever been made.

AN Oriental Institute expedition began work on this task in December, 1926, under Dr. K. S. Sandford as field director, assisted by Mr. W. J. Arkell. If this survey is successful, we shall be able to trace in one vast synthesis the advance of man as he

rose out of the geological ages, through the advent of civilization, to the earlier stages of the historical epoch. This synthesis would restore to us a whole series of heretofore lost stages in the history of life on our planet and give us a continuous picture where we have now a long series of disconnected episodes.

The Oriental Institute is a research laboratory for the investigation of the early human career, especially the transition from savagery to enlightened life; of the emergence of civilized societies; and of the Oriental background of European and American civilization. The action of the Trustees of the University of Chicago, creating the Oriental Institute in the spring of 1919, was made possible by the enlightened generosity of Mr. John D. Rockefeller, Jr.; and the subsequent growth of the Institute has likewise been due largely to the same generous donor, as well as to several appropriations by the General Education Board and gifts by Mr. Julius Rosenwald and others.

The Institute has dispatched to the ancient Near East six expeditions and is still maintaining five. The Institute's permanent headquarters building in Egypt is at Luxor. In Asia its headquarters building is at Armaged-

Palestine in command of the Allied forces, he was able to push back the Turks from one position to another until he reached the ridge of Carmel. Here, protected by the same ridge which had sheltered many ancient armies, Lord Allenby pushed his cavalry through the pass, cutting the enemy's forces in two, and won on this historic battlefield the last of the battles of Armageddon, and one of the greatest victories of the World War.

The great mound has never been investigated beyond a few trial shafts and exploratory trenches undertaken by a German expedition over a quarter of a century ago. As a whole it still awaits systematic clearance and may be expected to yield historical monuments of the greatest importance.

As far as known to us, the earliest battle fought here was the combat between the Canaanites and the Egyptian army of Thutmose III in the middle of the Fifteenth Century B.C. In 1925, the Oriental Institute was able to expand its work in Asia and to undertake the systematic exploration and excavation of this mound of ancient Armageddon.

The expedition, at first led by Dr. Clarence S. Fisher, and more recently by Mr. P. L. O. Guy, arrived on the site in the autumn of 1925. The task of building the headquarters was more or less of a race with the on-coming autumn and winter rains, and members of the expedition were more than once driven from their tents by the drenching rains of October before they were able to shift to the welcome shelter of the new house. This is built of heavy stone masonry with an American com-

position employed for the roofing.

Like "Chicago House" at Luxor, in Egypt, this Asiatic headquarters of the Oriental Institute is furnishing an opportunity for the training of young orientalists, but unlike Luxor it is possible for the staff to live here all the year round. Although very hot, the warm season from April to October is free from rain and permits an uninterrupted campaign of some six months of excavation.

BUILT each upon the ruins of its predecessor, any ancient city of the Orient usually rose in the form of a hill; and when such a city was destroyed for the last time by some catastrophe of war, its mound lay like a series of stratified geological deposits. Such is the present condition of the historic mound of Armageddon. In modern excavation, the entire area to be cleared is carefully surveyed and laid out in a series of small squares, each of which is numbered, so that the exact position of everything discovered may be accurately marked in these squares. The particular level at which each object is found is also accurately noted—for it will be obvious that the remains are on the top and, as the excavation proceeds downward, each successive level is older than the one above it.

In order to remove the rubbish, it is carried by the native workmen in baskets on their heads and loaded into modern steel dump cars running on tracks. The rubbish they contain is shot down the steep slope of the mound, away from the ancient buildings. Far below these workmen, in stratum upon stratum, lie the streets and buildings of the older cities, without doubt containing important monuments and records which it is the object of the Oriental Institute to discover.

Thousands of years ago the Stone Age men settled on this hill of Armageddon. Our excavations along the slopes have disclosed their stone implements.



THE FIELD OF OPERATIONS

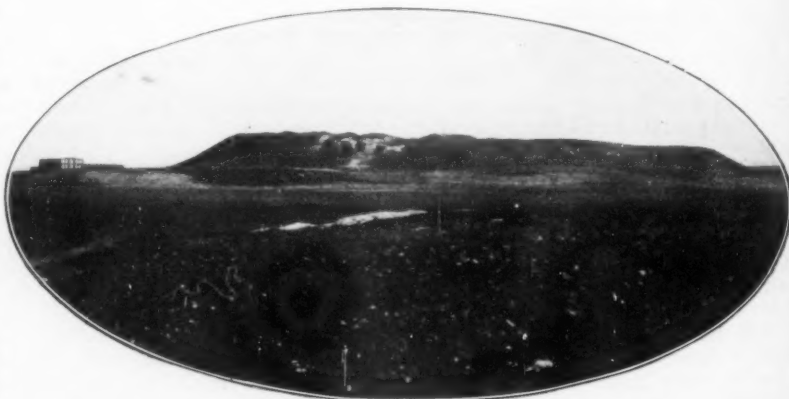
The reader will find on this map most of the localities mentioned by the author in the accompanying article

don in Palestine. The administrative center of the Institute in America is Haskell Oriental Museum at the University of Chicago, where the original monuments and documents from the field are housed and studied and home research projects are carried on. The following article can do little more than suggest the series of field operations in the Near East, by which the Oriental Institute is beginning the task of recovering the lost sources indispensable to our purpose.

The first venture of the Oriental Institute, immediately after its foundation, was a preliminary survey of the Near East, beginning in Egypt and extending through western Asia, especially Mesopotamia, with the purpose of developing plans for undertaking field work.

A GLANCE at the map discloses the fact that Palestine, the land of the Hebrews, lies directly between the great centers of Oriental civilization, that is, Egypt on the one hand and Assyria and Babylon on the other. The point at which these powers in their struggle for supremacy very commonly met was a transverse ridge in Palestine, of which the seaward end is called Mount Carmel. Guarding the pass through this ridge is the famous fortress-city of Armageddon, or Megiddo, which is the older Hebrew form of the same word.

The Plain of Megiddo has been the battlefield of the ages, and the stronghold of the city itself has been the key fortress guarding the highway between two continents. This fact was dramatically illustrated in the course of the World War. When Lord Allenby advanced from Egypt into



"AND HE SLEW HIM AT MEGIDDO"

The great mound of Armageddon (or Megiddo), once the strongest fortress-city of Palestine, commands the most famous battlefield of the ancient world. It is acres in extent

Above this earliest settlement will be that of the first metal users in Palestine, some 5000 years old; and over these levels will lie the strata of successive historic ages, culminating in the wealthy city captured by Thutmose III of Egypt in the early part of the Fifteenth Century B.C. The city remained in Egyptian hands for centuries and must be filled with monuments of the pharaohs, as well as with those of the great kings of western Asia. One such monument has already been found.

"AND it came to pass in the fifth year of king Rehoboam, that Shishak, king of Egypt, came up against Jerusalem; and he took away the treasures of the house of Jehovah and the treasures of the king's house; he even took away all: and he took away all the shields of gold that Solomon had made." (I. Kings, 14:25-26). It was to us an experience of no little interest when one of our Egyptian foremen brought down from one of the rubbish heaps of our predecessors at Armageddon a stone which he had noticed was inscribed with Egyptian hieroglyphs, and which proved to bear the name of the self-same Shishak, whom the Egyptians themselves called "Sheshonk," who invaded Palestine and Jerusalem in the Tenth Century before Christ. Scholars had been inclined to doubt that he captured the massive fortress of Armageddon, which Shishak's inscriptions on the temple at Karnak claim that he had taken. But here before us was the evidence which he had left on the spot—an impressive monument, the approximate size of which we could restore as a great slab of stone some ten feet high and five feet

wide, with a rounded top, which the Egyptian king had erected at Armageddon in the Tenth Century B.C.

Another of the widely separated oriental enterprises of the Institution was the Hittite Expedition. The re-

found no less than 55 new sites which could be identified as ancient Hittite settlements, towns, and cities heretofore unknown. He discovered a line of observation posts visible one from another, which served as a line of de-



EXCAVATIONS ON TOP OF THE MOUND OF ARMAGEDDON

Battles have been fought around this fortress from time unknown to the World War, when General Allenby fought there. The mound has a highly strategic location

cent decipherment of the Hittite documents written in cuneiform on clay tablets, has disclosed to us the prehistoric Greeks, centuries before they possessed any writing. We see them pushing over from the Greek mainland into Asia Minor—the irresistible prehistoric Greek expansion, likewise revealed to us in the records of the Medinet Habu temple at Luxor. Some of the hero kings of the Homeric songs are disclosed in these cuneiform tablets as historical characters, and even the name of Troy is found in these documents for the first time in a written source. Here then is the astonishing emergence of the Trojan wars, revealed as historical events in contemporary documents.

Exploration and discovery in these Hittite regions—especially the territory within the circuit of the Halys River—are still in their earliest stages. Not a single Hittite city has been completely and systematically excavated. A thousand questions arise on every hand, and one of the most important of these is the problem of the racial connection of the group of peoples commonly called Hittites. The fact that at least one of their languages is Indo-European in character connects these ancient people with our own ancestry.

In the summer of 1926 the Oriental Institute undertook a preliminary exploration in the Hittite country, with Mr. H. H. von der Osten as field director. He spent three months there, and his work has resulted in a series of interesting and important discoveries. Among these are several which deserve special mention here.

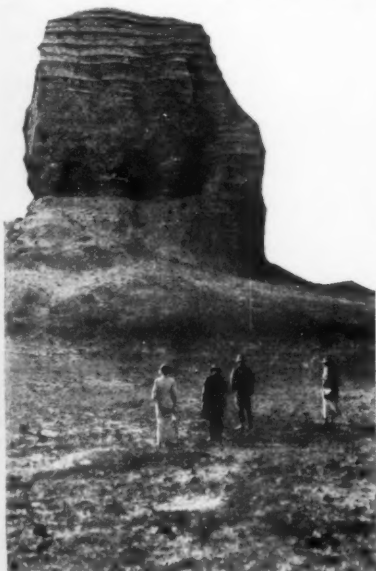
In the first place, Mr. von der Osten

fense; and he found postern passages cut as long inclined galleries in the rocks of the Hittite strongholds, for the rapid debouchment of troops. His discovery of a Middle Kingdom statue of nearly 2000 B.C., bearing an Egyptian inscription, which turned up in the ruins of Kurigin Kaleh, is of the greatest interest and suggests intimate intercourse between the Hittites and the Egyptians some 4000 years ago.

Swinging, now, to the work of the Institute, in Egypt: the personnel of a staff possessing the experience for successfully carrying on the work of saving the temple records of Egypt must be highly varied. There must be able photographers, draftsmen, and painters of the highest skill and long experience, besides competent architects with archeological training. Finally, the work requires experienced epigraphers, scholars who are acquainted with the ancient oriental languages and who can read the inscriptions.

THIS Egyptian outpost of the University of Chicago has been developed to serve two important functions: first, the task of saving the temple inscriptions of Egypt; and second, the opportunity, through its new library, of furnishing young orientalists with the facilities for continuing their professional studies in the field. Thebes is the center of such extensive ruins that this headquarters of the Oriental Institute should serve for generations as a home for study and research.

The skillful and scientific methods employed in this remarkable work in Egypt will form the subject of a special article to be published soon.—THE EDITOR



TEMPLE TOWER OF AKERUF

In Upper Babylonia. Note how the resistant layers have delayed the erosion

Our Point

IN SEARCH OF WEALTH

ELSEWHERE in this issue we publish what we consider to be the best general treatise on geophysical prospecting available in English; those who enjoy reading German may seek out Dr. Richard Ambrohn's notable textbook, of which a translation is promised.

Now that geophysical prospecting for minerals has passed the probationary stage among mining men and been taken into their community with full standing as an aid to other methods, a great deal of comment is trickling down to the newspapers, with the inevitable "trimmings," some of which are florid, to say the least. Hence the psychological time has come for this journal to publish something both accurate and authoritative.

Several years ago when the editor first became interested in this method of seeking hidden minerals, it was receiving but short shrift from some of the mining journals. Today the danger seems to be that even too high expectations will be engendered by the lofty claims made by some of the more enthusiastic among its converts. Not one of these methods actually finds ores, but only, as Dr. Max Mason, President of the University of Chicago and one of the leading authorities on geophysical prospecting, says, "some physical characteristics usually, but not exclusively, associated with ore."

None but thoroughly trained geologists are competent to conduct the investigations. Practical courses in the several methods are now being given at the Colorado School of Mines by Professor C. A. Heiland, enrollment being limited to senior and graduate students in mining; also by Dr. Eve and Dr. Keys at McGill University.

Virtually none of the apparatus may be purchased outright, most of it being made up on the user's specifications or employed only by special corps of trained technicians sent out by the various exploring companies. The oil producers are known to be using several scores of torsion balances, especially in Texas, and important finds have been made. In Canada ores have been found by various geophysical methods within recent months.

A TIMELY WARNING

M. BUNAU-VARILLA, Chief Engineer of the Panama Canal before the United States took over the

work, has done good service in drawing attention to the one insuperable and unchangeable obstacle to the construction of a canal, 110 miles long, across the isthmus at Nicaragua. The canal would lie within a zone of continual and, at times, very serious earthquake disturbance. It was largely because the Isthmus of Panama is free from such menace that it was chosen in preference to Nicaragua. Evidence of this was found in an ancient ruined church, where a thin and very shallow arch is still standing, some 200 years after the church was burned down. During the 20 years that have elapsed

Plunkettism Unpopular

IT is the clear duty of the naval officer to do everything that he legitimately can to build up the navy. As an authority on a complicated technical subject which the layman has neither the training nor the time to master, he should use every opportunity to explain why the country's fleet should be carefully balanced both in its component parts and in its relation to the fleets of the other great powers.

Such an explanation is legitimate when it is based upon reason; but when an appeal is made to passion, race prejudice, suspicion and fear, it is simply deplorable. A navy built up upon such motives would be a spite navy and the American nation as a whole has no use for a spite navy. The sweeping cut in the House Committee from 71 ships to 16 is proof of our friendly attitude. Had it not been for the fatuous policy of "saber-rattling" so freely indulged in by Admiral Plunkett and a few others of his ilk, the cut in Secretary Wilbur's proposals would certainly have been less drastic.

since the United States took over the enterprise there have been only a few very mild tremors.

At Nicaragua, on the contrary, there are three large volcanoes and many smaller ones, that would be a constant menace to the great engineering work—dams, locks, and long retaining walls, that would have to be built. But let Bunau-Varilla speak for himself: The advocates of the canal "forget that, with the huge dams and locks necessary, all made of stiff material, it is

almost crazy to entrust such a gigantic rigid piece of engineering to the volcanic and continually vibrating soil of Nicaragua. Some thousands of United States Marines may keep down the upheavals of the political volcanoes of Nicaragua. All the forces of the United States, all her gold, all her technical genius will not prevent Momotombo, the Masoya, the Omotopo and their many brother volcanoes from spouting flames and ashes, and their gigantic eruptions from shaking to earth the dams and the locks which engineers, lacking observation and foresight, may be led to erect at their base."

Bunau-Varilla in his letter to the *New York Times*, then restates his well-known plan for eliminating the locks at Panama by cutting the canal down to sea level and thus providing an unobstructed waterway from ocean to ocean. But because there is a difference of 20 feet in the tides (2 feet rise and fall at the Atlantic end and 22 feet at the Pacific) a lock would be necessary to prevent a strong current through the waterway. He would make the canal 1000 feet wide. Undoubtedly this ambitious scheme could be put through; but nature, as at Culebra, would take charge of the slopes, and instead of 1½ to 1, the slides would not become quiescent until the disturbed, half-formed rock had found its natural angle of repose at 7 to 1.

Some day, no doubt, the canal will be cut to sea level; but the building of another reservoir at Alajuela, farther up the Chagres River, and the doubling of the present locks will take care of the traffic for several decades to come.

PER CAPITA GENIUS

THE sociologist who recently asserted that "modern man is superior to the ancient Greeks in every way, intellectually and in beauty of figure," leaves us somewhat doubtful by his own reasoning. To exemplify his statement, he says that, although we consider the few exquisite Greek sculptural pieces extant as indicative of the beauty of the Greeks as a nation, these are, in reality, composite pictures of many models: one posed for the torso, another for the head, another for the eyes, the ears, the legs, and so on. So it is with our conceptions of other details of ancient life: we find a few artifacts, or a few bones and judge a race thereby.

of View

There is no doubt that man has, in the last few decades, achieved the presumably impossible and has advanced so far in science and general knowledge that "Main Street" talks, more or less intelligently, of protons and electrons, of heredity and chromosomes (shades of the Jukes and Edwards families!), of relativity and light years, of social problems and free love and companionate marriage. And then again, it talks of money and bribery, of divorces and scandals, murders, bootlegging, presidential elections, and what not.

Medical science has improved us physically, yet we have produced not a single Hyacinthine specimen. Learning, in general, may have improved us but where among us is a Socrates? We aren't all morons but not a few of us are quidnuncs.

Our superiority is thus judged exactly as our defender says we have judged the ancients: on the example of the few. We claim one genius for every million or so inhabitants of the civilized world. One small island of the ancient world produced a genius for every 5000 inhabitants. Consider our superiority and be proud!

STOP

AESOP'S fable of the shepherd boy who so frequently cried "Wolf, wolf" when there was no wolf, only to lose his flock when a real wolf came, is aptly brought to mind by a fact recently pointed out by Dr. Knight Dunlap, psychologist at Johns Hopkins. We employ red as a danger signal. It means "Stop." Yet in effect we so frequently cry "Wolf, wolf" by using red for every other purpose than as a danger warning, that red is now losing, in a measure, the very significance for which it was originally intended.

Motorists, especially, who should be able to react instantly, instinctively and entirely automatically the moment a red warning signal is flashed, can no longer do so. Instead, they must ask themselves each time they see red whether to stop or whether it is simply one of a myriad of other reds used indiscriminately on our streets for advertising purposes, for decoration and what-not. Each decision takes time and a split second may mean much. Moreover, the too-frequent use of red tends to deaden the mental alertness to it.

As a warning color, red is rapidly

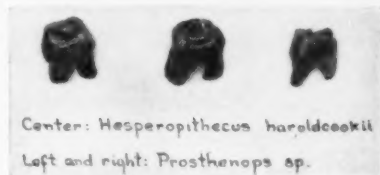
losing value. Why not restore it?

THE OPPONENT'S ROUND

THE Reverend Mr. John Roach Straton is planning to enjoy a lot of fun with science because Dr. Henry Fairfield Osborn, President-elect of the American Association for the Advancement of Science and President of the American Museum of Natural History in New York, has reversed decision on *Hesperopithecus haroldcookii*, the famous tooth of "Harold Cook's western ape," after six years of insistence that

if displayed a little more on both sides, would resolve many of the present evolution battles into good natured pillow fights and set the enemy camp to looking for facts instead of mere wordy arguments.

Now about that tooth: lots of people, even on our side, are seemingly at a loss to understand how the tooth of a peccary (ancient pig-like beast) could



Center: *Hesperopithecus haroldcookii*
Left and right: *Prosthenoops* sp.

Growing Pains

JOBs are scarce. There is a great deal of unemployment, and before there is less there may be more.

This is a little bit puzzling. Isn't the nation prosperous? Haven't things been running along in great shape? Why should men be out of work now, when there is so much excess wealth?

Just because there is so much excess wealth.

Men are out of work now because our machine has functioned so efficiently; because so much work has been accomplished. Machinery, ever growing in productive power, multiplying the man by more and more, has created a surplus of production.

Logically, then, we should all work less. Instead, most of us are working as hard as ever and so a few of us can't find work at all.

This is no sign of lost prosperity; quite the reverse. All we need do is make a rearrangement. The five day week looms. And continued prosperity.

possibly be confused with the man-like tooth of an ape, at least by an anatomist. Were it a perfectly good tooth this would be about true, but *Hesperopithecus* was a pretty poor fossil to begin with. The tooth is broken at the roots, eroded on the sides and almost entirely worn away on the crown or chewing surface where the little hills and grooves (*sulcae*) which serve as the chief identification marks of a tooth should be. And then, to start with, the upper molar tooth of a certain fossil peccary is surprisingly similar to the molars of man and ape when compared with those of other mammalian forms. However, this might call forth from the "enemy" the retort that the knowledge of these facts should have made the scientists more careful.

Probably a large share of responsibility for identifying *Hesperopithecus* as an ape fell on the paleontologist, Dr. William K. Gregory of the American Museum. But Dr. Gregory also deserves a world of credit for reversing his decision after six years, knowing as he must have known, when he did it, that the story of the ape's tooth that was reduced in station to that of a Pliocene pig, would surely be triumphantly intoned in the songs of hate of every anti-evolution gathering for a century to come. However, among scientists Gregory has a reputation for caring naught for personal feelings or ultimate effects. He makes his decisions judicially on a basis of the evidence alone as he sees it. This, of course, is the ideal method of science and no scientist better exemplified it than Darwin himself, as his writings show.

Thus science moves steadfastly on, just as if there were no anti-evolutionists tugging at her coat tails.

it really was the molar of an ape. It looks as if Straton had morally won this round and it might possibly work out a lot nicer if we of the scientific camp were to concede it gracefully and get ready for the next one.

Straton wants to debate Osborn, with the Reverend Mr. Potter (whom Straton once beat in a famous debate, largely by quoting as an "authority" George McCready Price's so-called "Geology") acting as Osborn's sponge holder, and with Will Rogers as his own second. This is the first sign we have seen that Straton possesses a sense of humor; and a sense of humor,

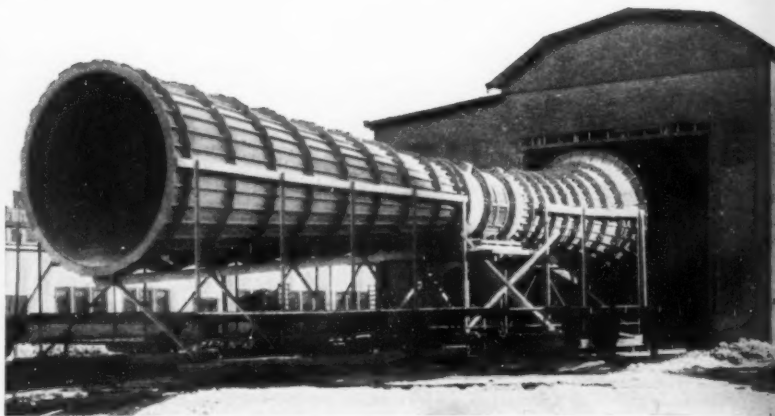
From the Scrap-book of Science—



International Newsreel

GAS MASK TESTING

Firemen's and miners' life-saving equipment is tested thus in London. Poison gas from adjacent chamber is breathed and the exhaust gas is carefully tested



WIND TUNNEL

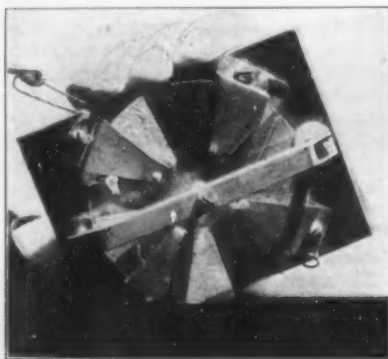
Made for Department of Aeronautical Research at Massachusetts Institute of Technology, being placed in the Daniel Guggenheim Laboratory. Length is 81 feet; diameter is seven feet at center, and 15 feet at ends



P and A

ROLLER BOAT

An ordinary tin can rolling on the water was the inspiration for this unique boat recently built and tried out by "Uncle Ed" R. Thomas, formerly of Buffalo, New York, and now of Miami Beach, Florida. It utilizes two galvanized iron drums which roll on the water, the propelling power being an outboard motor shown here in the center on the supports



©Harris and Ewing

STATIC MOTOR

C. Francis Jenkins, Washington, D. C., designed this motor which runs solely from air static, when connected to an aerial and a ground. Rotor diameter of tiny motor is three and one half inches

ARCADE HIGHWAY

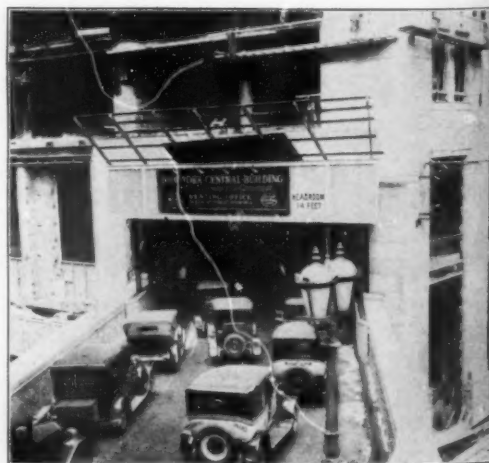
Known as Depew Place, this roadway through the New York Central Building was recently turned over to the traffic division of the New York Police. In effect a tunnel, it will facilitate control of heavy traffic here



Acme

UNITED STATES' LONGEST TUNNEL

Formal opening of the Moffatt Tunnel through the continental divide. It shortens by 25 miles the trip spanning the divide, and the trip between Denver and Salt Lake City by about 170 miles. About six miles long, it cost 18,000,000 dollars



International Newsreel

Camera Shots of Scientific Events



Frank A.



Underwood and Underwood

FLOATING ROADWAY

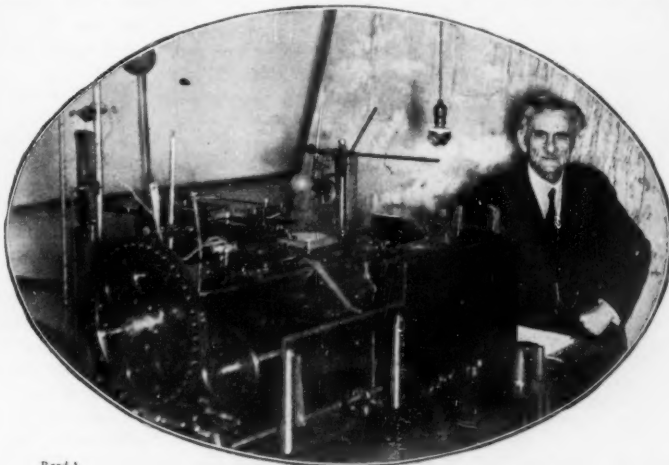
This underpass, at South San Francisco, is built three feet below sea level on a mud and water base. It is held firmly by 600 steel anchors which keep it from buckling and breaking up



International News

FOSSILS OF FISH-LIKE REPTILE

Reptiles called Plesiosaurs, which looked like fishes and lived in the sea, were common 180,000,000 years ago. This one's fossils were recently found in England. It had a rudimentary third eye on top of its skull. Its length is 16 feet



Frank A.

10,000 LINES TO THE INCH

Dr. Albert A. Michelson, Professor of Physics at the University of Chicago, winner of Nobel Physics Prize, is shown here with his remarkable ruling machine which rules the lines on a diffraction grating, 10,000 to 50,000 to the inch and absolutely parallel. Speculum metal is used and the line-ruling tool is a fine diamond point

TESTING EMOTIONS

A love-thriller "movie" was recently shown in New York City to many types of women and their emotional reaction (note chest bands) recorded by Dr. William M. Marston, psychologist of Columbia University



Henry Miller News

SOLAR RADIATION

Harlan H. Zoltner of the Smithsonian Institution will take this pyroheliometer to Mt. Montezuma in the Andes where, for three years, he will measure and record the radiation of the sun



Acme

The Earth As a Magnet

How Is the Earth's Electric Charge Constantly Maintained? One of the Greatest Unsolved Problems of the Science of Atmospheric Electricity

By W. F. G. SWANN, D.Sc.

Director, Bartol Research Foundation of the Franklin Institute
Formerly, Professor of Physics and Director of the Sloane Laboratory in Yale University

THAT the earth is electrically active at times is a fact familiar to all, for we have all witnessed a thunderstorm. It is not so generally known, however, that even during the ordinary fine days our earth is the seat of very interesting electrical phenomena. Its surface is not elec-

trically neutral, but is coated with a charge of negative electricity of such an amount that the electrical pressure difference between the surface and a point a yard above it is greater than the normal electrical pressure difference between the terminals of our lighting circuits.

However, small as is the conducting power of the atmosphere, it is nevertheless sufficiently large to permit the escape of 90 percent of the earth's charge in 10 minutes if there were no means of replenishing the loss. The source of the replenishment of this loss is the great mystery of atmospheric electricity.

The small conductivity of the atmosphere is quite capable of measurement by modern means, and its origin is known. It is due to the presence in the atmosphere of what are called ions. In order to explain what an ion is we must make a slight digression.

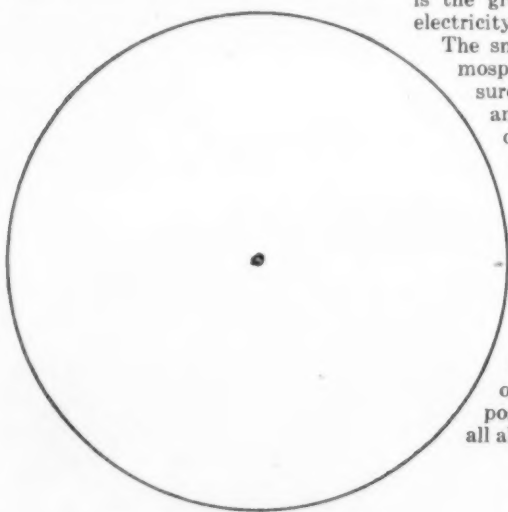
WE believe that the molecule of any substance is built up of particles of positive and negative electricity. The negative particles, or electrons, are all alike and the positive particles, or protons, are all alike. The electrons and protons carry equal but opposite charges. However, the proton is 1800 times heavier; yet, strange as it may seem, 1800 times smaller in diameter than the electron. The mass of the proton is so small that if we should magnify the mass of everything so that the proton attained a mass of about four ounces, that four ounces would, on the same scale of magnification become as

heavy as the earth. Its size is so small that if we should magnify it to the size of a pin's head, that pin's head would, on the same scale of magnification, attain a diameter equal to the diameter of the earth's orbit around the sun.

BY the aid of certain agencies it is possible to detach an electron from a neutral molecule, leaving the residue positively charged. This residue is the positive ion. The electron rapidly attaches itself to some other neutral molecule, and the resulting entity is the negative ion. When we have charged bodies in air containing ions, the ions, being themselves charged, move towards the bodies, negative to positive and positive to negative, and by their motion they constitute the current of electricity by which the bodies become discharged.

Under normal conditions in the atmosphere there is only about one ion for every ten thousand million million molecules of air, so that if a molecule of air should go about saying that it had once seen one of its brethren which had lost an electron the story would be far less likely to be believed by the other molecules than would that of a single miracle which had been observed by only one person since the dawn of history be believed in the community of men.

The agencies responsible for producing ions by ejecting electrons from molecules are primarily two in number. First we have the radiations which are



SOME INCONCEIVABLES

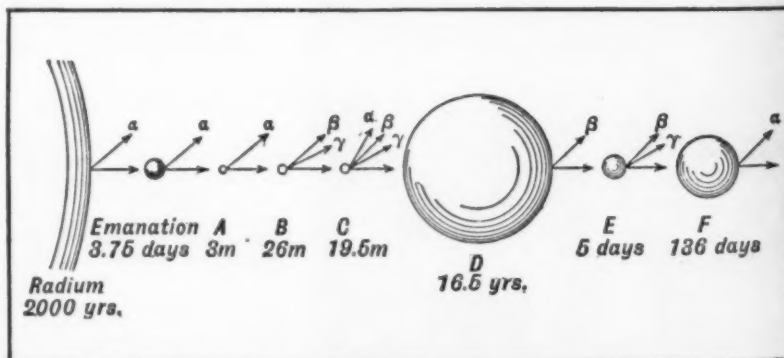
The circle is the electron; the central dot the proton magnified ten diameters. On this scale a hydrogen atom would be six miles in diameter

trically neutral, but is coated with a charge of negative electricity of such an amount that the electrical pressure difference between the surface and a point a yard above it is greater than the normal electrical pressure difference between the terminals of our lighting circuits.

THE difference of electrical pressure between the earth and the atmosphere increases with altitude, but at a diminishing rate until at an altitude of about seven miles it ceases to change further to any appreciable extent, having there attained a value of more than 150,000 volts.

Now the atmosphere is a conductor of electricity. It is a very feeble conductor—so feeble that a column of air one inch long offers as much resistance to the flow of the electric current as would a copper cable of the same cross section extending from here to the star

nify the mass of everything so that the proton attained a mass of about four ounces, that four ounces would, on the same scale of magnification become as



From Kimball's College Physics (Henry Holt and Company)

DIAGRAM OF RADIOACTIVE TRANSFORMERS

The sizes of the spheres represent the relative amounts of the various products that are present in a mass of radium which is undergoing change in the well known sequence

emitted from radio-active substances; like radium. A substance like radium is in a continual state of disintegration. If you should buy an ounce of radium today, only half an ounce would be left 2000 years hence.

As the radium dies it gives birth to a gas known as radium emanation. This, in turn, dies; half of it disappearing in about four days, giving birth as it does so to another substance known as radium A. Half of this is gone in 3 minutes, giving rise to radium B; and so on.

NOW when any one of these substances dies, giving rise to the next in succession, the death is accompanied by the emission of one or all of three kinds of radiation. First we have the alpha particle, which is a positively charged atom of helium traveling with a velocity of about 18 miles per second, and having a kinetic energy per unit mass equal to about 400,000,000 times that of a rifle bullet. Then we have the beta ray, which is simply an electron traveling with a speed comparable with that of light, a speed of about 186,000 miles per second. Finally, we have the gamma ray, which is simply an ether wave of extremely short wave length, a length so short that about 10,000,000,000 of these waves could be crowded into the space of an inch. All of these radiations possess the power to eject electrons from the molecules of a gas through which they pass, and by this action they give rise to ions, as already explained.

There is only about one molecule of radium emanation in the atmosphere for every ten million million molecules of air. In the soil there is only about one molecule of radium for every five million million molecules of the soil. Nevertheless, these relatively insignificant amounts of radio-active material are capable of contributing quite appreciably to the atmospheric conductivity.

The second agent responsible for

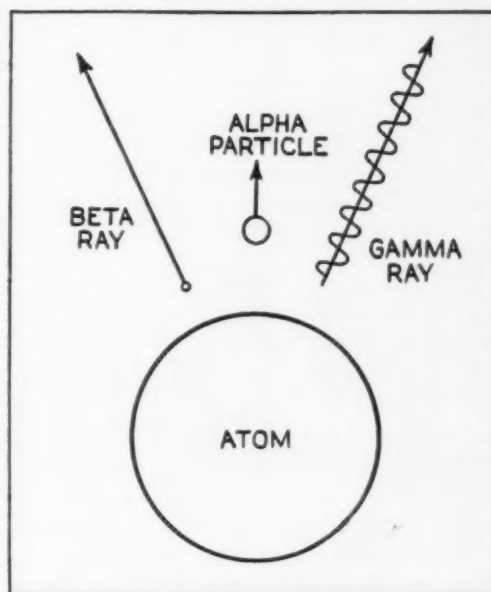
the electrical conductivity of the atmosphere is the "Cosmic Radiation." As light is composed of waves very much shorter than radio waves, as X-rays are composed of waves very much shorter than light waves, as gamma rays are composed of waves shorter than X-rays, so these cosmic rays are composed of waves very much shorter than the waves of gamma rays. They appear to come from sources outside of our solar system, and may be born in the stars, in those cauldrons where, as modern science suggests, the atoms of matter itself may be formed.

MANY suggestions have been made to account for the maintenance of the earth's charge. Several years ago, Dr. G. C. Simpson suggested that the Sun might emit positively and negatively charged particles with great velocity. He suggested that the penetrating power of the negative particles might be greater than that of the positive particles to such an extent that while the positive were caught in the atmosphere, the negative passed right through the atmosphere to the earth. Under such circumstances the earth would charge negatively and the atmosphere positively until the tendency of the charges in earth and atmosphere to mix through the agency of the conducting atmosphere just balanced the charging action referred to. One of the chief difficulties confronting this idea arises from the fact that the swiftest charged particles we are acquainted with are able to pass through only about nine yards of air at atmospheric pressure.

It is known that small particles will promote the precipitation of rain in a moist atmosphere; and even the ions in a gas may, under suitable conditions, be made to serve as centers for the deposition of water drops. Since negative ions are known to promote condensation more readily than positive ions, it was suggested many years ago by Mr. C. T. R. Wilson that the replenishment of the earth's charge might come about through the agency of rainfall. However, experience has shown that the conditions necessary for the precipitation of water on ions can not occur normally in the atmosphere. Further, observations show that, on the average, rain brings

down more positive than negative electricity.

When air containing ions diffuses through small pores, it is found that the negative ions get caught in the walls of the pores more readily than do the



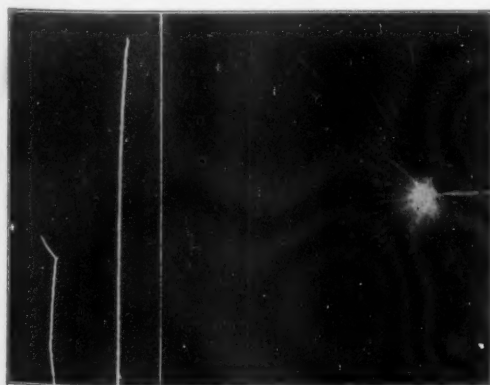
THREE KINDS OF RADIATION

The alpha and beta rays are particles; the gamma rays are vibratory like light, but of far higher frequency

positive ions. Now the air in the pores of the soil is relatively highly ionized, so that as it is sucked out of these pores during the periods when the barometric pressure is falling we may expect to find that it emerges positively charged and that the earth from which it comes retains the complementary negative charge. Such an explanation of the maintenance of the earth's charge was advanced by the German physicist Ebert, many years ago. Ebert supposed that as the positive ions came out of the soil they were carried by upward air currents into regions of all altitudes, in spite of the tendency of the negatively charged earth to hold them down. Unfortunately, when this theory is examined in detail from the quantitative standpoint, it does not appear to be capable of accounting adequately for the origin of the earth's charge.

ABOUT 10 years ago the writer sought to correlate the mystery of the origin of the Cosmic Radiation (then known as the "penetrating radiation") and that of the origin of the earth's charge into one mystery.

We know that when rays such as we believe the cosmic rays to be eject electrons from the atmosphere, those electrons come out almost entirely in the direction in which the cosmic rays are going. The cosmic rays are like bullets fired downwards from a lot of



Courtesy Cambridge Instrument Co.

ALPHA RAY TRACKS

Photographed before and after expansion. The two groups in the photograph were combined merely for convenience

CONDENSED TABLE OF ETHERAL WAVES IN OCTAVES					
WAVELENGTH	STANDARD	WIRELESS TEL.	WAVELENGTH	STANDARD	
15600		ARBITRARY STARTING POINT	242		
11200	1	TRANS-OCEAN	190	27	LONGEST HEAT WAVES
6400	2		95	28	
3200	3	USED BY LARGE SHIPS	47	29	
1600	4		24	30	INFRARED
800	5	USED BY SMALL SHIPS	12	31	
400	6		6	32	RADIATION
200	7		3	33	
100	8	BROADCASTING AND AMATEURS	1.5	34	
50	9		0.75	35	SHORTEST HEAT WAVES & EXTREME VIO. RED
25	10	LONGEST HERTZIAN WAVES CHIEFLY USED BY HERTZ IN HIS CLASSICAL EXPERIMENTAL WORK	3750	36	VISIBLE LIGHT
12.5	11		1075	37	DANGER TO EYE BEGINS HERE AND INCREASES WITH SHORTER WAVES
6.25	12		937	38	
3.125	13		468	39	ULTRA-VIOLET RADIATION
1.56	14		234	40	
781	15		117	41	
390	16	HERTZIAN	58	42	
195	17	RADIATION	29	43	
97	18		14.5	44	FIRST PERCEIVED X RAYS
48	19		7.25	45	
24	20		3.6	46	
12	21		1.8	47	
6	22		0.9	48	X RAYS
3	23	SHORTEST WAVES PERCEIVED BY EYE	0.46	49	
1.5	24	PERCEIVED AND MEASURED BY MICHELSON AND TOLAN IN 1911	0.23	50	
0.75	25		0.115	51	
0.36	26	SHORTEST HERTZIAN WAVE	0.057	52	GAMMA RAYS.
			0.028	53	—AND SHORTER

Courtesy the General Electric Review

THE ELECTROMAGNETIC SPECTRUM

All of these rays are identical in nature (undulatory). They differ only in frequency or the resultant wavelength.

guns in space, and the electrons which are knocked out of the atoms by these bullets continue the downward flight. Those electrons which are ejected from the upper regions of the atmosphere will be absorbed by the layers of air below, but nevertheless, the earth will receive electrons from those layers of air which are, as it were, within striking distance of it. The farther the electrons are able to travel through the air without absorption the greater the thickness of the atmosphere from which electrons will be fired into the earth.

trons could pass. Experiments carried out by the writer, using a cylinder of copper about eight inches in diameter and eight inches high, showed that the absolute magnitude of the current absorbed by the cylinder was not more than $1\frac{1}{2}$ percent of that which would have been obtained by the complete absorption of a vertical electron current of density sufficient to account for the replenishment of the earth's charge.

The second difficulty inherent in attempts to explain the earth's charge by high speed electrons comes from the

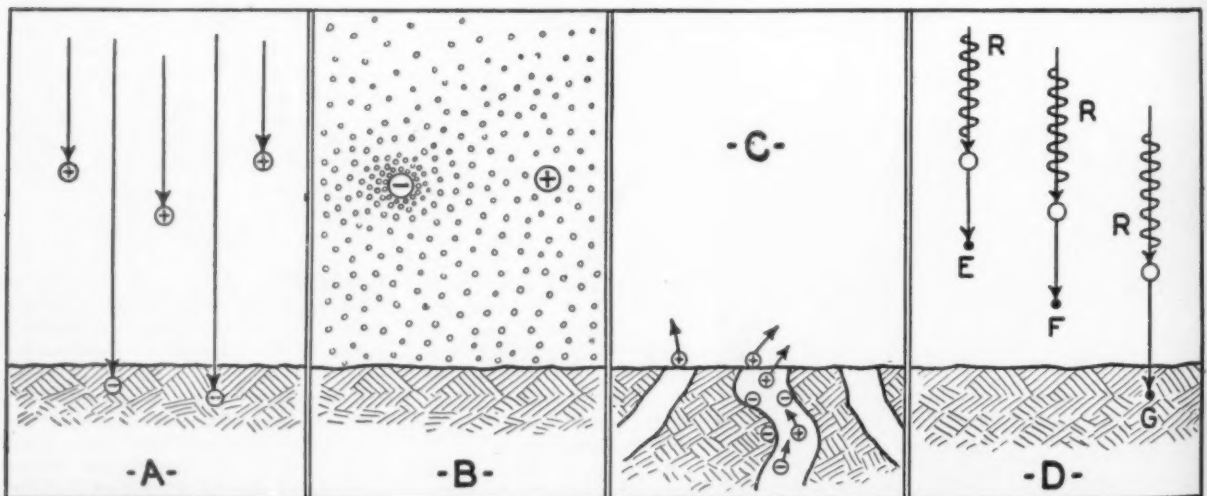
It appears, as a result of calculation, that the replenishment of the earth's charge could be accounted for satisfactorily by supposing that each cubic inch of the air supplied about 45 electrons per second, and that these electrons were of such speed that they could travel a distance of about nine yards through the air without absorption. These assumptions are not at all inconsistent with what might be expected from experimental evidence.

Two primary difficulties confront any attempt to explain the earth's charge through the agency of high speed electrons shot into it. If such electrons exist, we should expect that an insulated heavy mass of metal would become charged by exposure to the radiation, and it should be possible to guard against the loss of this charge through conduction into the atmosphere by surrounding the heavy mass with a thin shield through which the incoming elec-

ionization which these electrons might be expected to produce in the air through which they pass. If the electrons should behave like beta rays from radium, a stream of them strong enough to maintain the earth's charge would, on passing through the atmosphere, produce 10,000 times as much ionization as is found. While it is possible to surmount both of these difficulties in a comparatively reasonable manner, one cannot resist the temptation to speculate further and seek, in some more complete generalization of our physical laws, the key not only to the origin of the earth's charge but also to the origin of its sister phenomenon, the earth's magnetism and the force of gravitation.

THAT the earth acts like a huge magnet, with the line joining its north and south magnetic poles coincident, to a rough approximation, with the earth's axis of rotation has been known for a very long time. In seeking an explanation of this state of affairs one's first thought is to the effect that the interior of the earth may be made of some magnetizable substance and that some how, at some time or other, the earth became magnetized. We can not escape the necessity of an explanation so easily, however; for our experience leads us to believe that a permanent state of magnetization, in the ordinarily understood sense, cannot exist at temperatures such as those which we believe to prevail in the earth's interior.

A sphere carrying electric current flowing in circles concentric with a diameter would act like a magnet; but how are such currents to be accounted for? The earth's negative charge contributes an electric current by its rotation, but this current is 100,000,000 times too small to account



Redrawn from a sketch by the author

THEORIES THAT HAVE BEEN PROPOSED TO ACCOUNT FOR THE EARTH'S ELECTRIC CHARGE

A represents positive particles from the sun caught in the atmosphere, as described in the text; B the rain-drop theory; C the theory involving

ionized air diffused from the soil; D ejection of electrons by cosmic radiation which should be subjoined to table at top of this page

for the earth's magnetic state. The atoms of which the earth is composed contain, in the aggregate, a very large amount of positive and negative electricity. A cubic centimeter of the earth contains so much positive and negative electricity that if these two amounts could be separated and concentrated at two points a centimeter apart they would attract each other with a force of a hundred million million tons.

EACH of these huge charges of electricity within the earth produce by the earth's rotation a magnetic field intensity ten million million million times the magnetic field intensity of the earth; but the fields are in opposite directions so that they annul each other. The magnetic field intensity produced by a charged sphere depends upon its radius for a given total charge.

It would only be necessary for two concentric spheres of the size of the earth, one of negative and the other of positive electricity of amount equal to that in the earth, to differ in radius by one 25th of the 1,000,000,000th of an inch, in order that when superposed and rotated together with the angular velocity of the earth they would give a magnetic field intensity equal to that of the earth.

Tempting as this idea seems as a suggestion for the origin of the earth's magnetism, it turns out that the electrical forces which would come into play in order to resist even such a small lack of uniformity in electric density as we have cited, are so enormous that we are unable to find any obvious causes of sufficient magnitude to bring such a condition into existence.

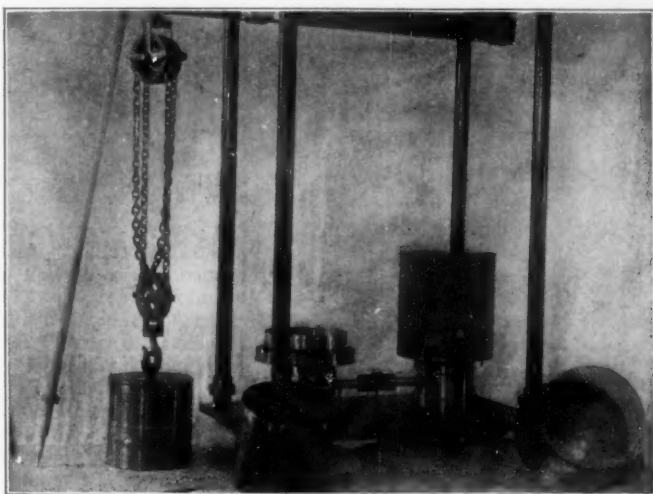
However, even with superposed spheres of positive and negative elec-

tricity for example if we should thin it out everywhere to half its former density and make it move with twice its former velocity.

The question therefore arises as to whether it may be possible to make some small differentiation between the

electricity for example if we should thin it out everywhere to half its former density and make it move with twice its former velocity.

However, the motion of a particle in the circle is not to be described en-



APPARATUS USED IN ONE EXPERIMENT

A cylinder of solid copper, eight inches in diameter, was used to test the theory that the earth's electric charge is maintained by high speed electrons shot into it

laws for positive and negative electricity such as to secure the end in view.

A THEORY to this effect has been developed by the writer. In its most general aspects it applies to all kinds of motion of electricity, and is far too involved to yield to presentation in a small space; but, by confining ourselves to the case of primary importance for the earth's magnetism, that of the uniform rotation of a symmetrical body, it may be possible to give a brief outline of its content.

Let us think of a circular hoop of matter in rotation, and let us concentrate our attention on the positive electricity in that hoop. According to classical notions, that positive electricity produces, by its motion, a magnetic influence at each point in its neighborhood, which magnetic influence the physicist knows how to measure and which he calls the intensity of the magnetic field, or simply the field, at the point.

Now our ordinary laws teach us that the intensity of the field is determined simply by the electric current in the hoop, that is, the quantity of electricity passing by any cross-section of the hoop per second. In this particular case it is simply the amount of electricity per unit volume and the velocity of its motion which are together concerned in producing a magnetic effect. According to the classical theory we should obtain the same magnetic field due to the positive

tirely in terms of its velocity. The particle has, at each instant, not only a velocity along the tangent to the circle of its motion but also an acceleration directed towards the center of that circle. Moreover, even this acceleration is not constant along any one line, but changes its direction continually as the line joining the particle to the center of the circle continues its rotation. There is, perpendicular to the acceleration, a rate of change of acceleration; and, by continuing the argument we can show that there is a rate of change of this rate of change; and so on ad infinitum.

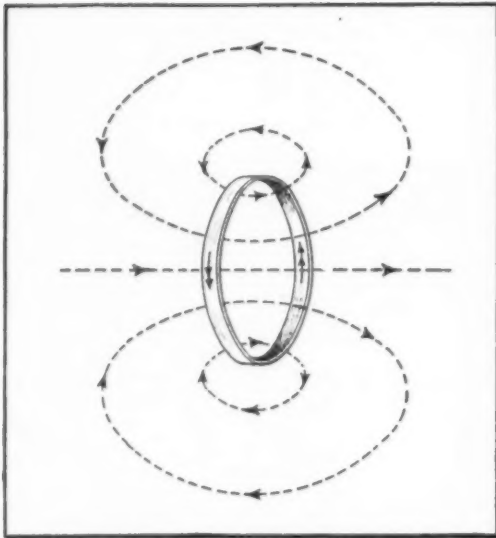
NOW one feature of the theory we are discussing involves the supposition that each of these additions to the motion acts in large measure like the velocity of the electricity in producing magnetic field intensity, but in very small degree. We make this supposition only for the positive electricity however, and not for the negative, so that when we imagine the negative electricity of the earth superposed upon its counterpart, the positive electricity, and consider the two rotating together, we find a lack of cancellation determined by the additional magnetic effects of the positive electricity referred to above.

But this is not all. The addition of these extra magnetic effects reacts on the whole electro-dynamic theory in such a way that the positive electricity in rotation is gradually killed. Our old classical theory presents us with no such phenomenon. It contains as one of its consequences the fact that elec-

A COMPARISON

If we should attempt to represent on the scale indicated by the surrounding circle, two spheres of opposite charges equal in amount to that on the earth, which when superposed and rotated with the earth's angular velocity would give a field intensity equal to that of the earth, we should have to draw the circle with a line 60,000,000,000,000,000 times thinner than the line with which the circle is drawn, in order that the thickness of the line would represent no more than the difference in radii between the two charged spheres

tricity of exactly the same size, an almost insignificant difference between the behaviors of the two kinds of electricity is all that is necessary to



A CIRCULAR HOOP IN ROTATION

Positive electricity revolving in the direction indicated by the double-headed arrows produces in the space around it a magnetic influence directed by the single-headed arrows

tricity can only disappear from any given space by going out of that space. It cannot simply fade into nothingness. The addition of the extra magnetic effects not only permits such a death (or birth) of electricity but actually demands it for the case where the electricity is in any state of motion but the very simplest.

On the basis of our theory, a rotating earth would not only give rise to magnetic effects but would insure the gradual death of the positive electricity, with the result that there would be an ever-increasing surplus of negative which would pile up until the rate at which it was carried away into space by atmospheric conduction was equal to the rate at which the surplus was provided. In order to account for the measured atmospheric electric current it is only necessary to provide for a very slow rate of death of positive electricity, a death so slow that only one half of 1 percent of the earth's mass would disappear in a hundred million million million years.

THE force of gravitation becomes imported into the theory in a manner very similar to that adopted in a theory due to Professor H. A. Lorentz and published many years ago. This theory assumes that the forces of attraction between equal unlike charges are slightly greater than the forces of repulsion between corresponding like charges, so that a positive and negative unit taken together would on the whole attract another combined positive and negative unit, and a whole set of positive and negative units forming a neutral body would, on the whole, attract another neutral body made up in the same way.

In incorporating these various ideas

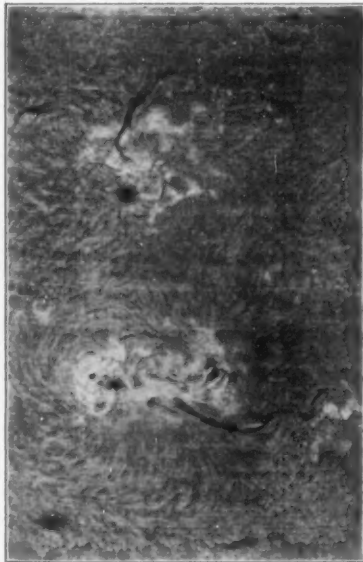
fact is, of course, of some importance as such fields, if they had existed in measurable amount, would have been discovered long ago.

THERE are two relatively simple forms of the theory which would be consistent with the foregoing requirements. In one, the magnetic field is proportional to the product of the density, angular velocity and the square of the radius, and in the other, it is proportional to the density and to the fourth power of the product of the angular velocity and radius.

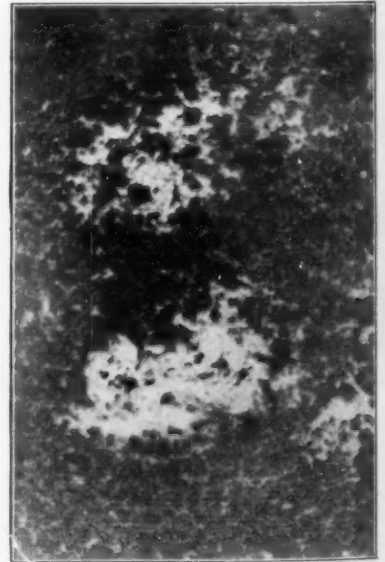
It may perhaps be permissible to indulge in certain rather speculative con-

siderations as to the consequence of the second form of the theory. In the first place it may be made to provide an explanation of the enormous magnetic fields of sun spots. These magnetic fields are about 5000 times as large as that of the earth. They have been attributed to huge whirlpools of electrons within the sun spots, but no very satisfactory explanation has been given to account for the origin of these whirls.

ON the view set forth in this article, the magnetic field could arise from the mere rotation of the neutral matter of the sun spot. We know that the rotational velocity of the solar gases in sun spots is very high, and it turns out that a not unreasonable peripheral velocity of the order of 80 kilometers per second would be sufficient to give rise within the spot, to a magnetic intensity comparable with the intensities found. The same form of the theory when applied to the planet Jupiter, whose radius and angular velocity are respectively eleven times and two and a half times those of the earth, predicts for that planet a magnetic field at its surface about a hundred thousand times that of the earth. We have reason to believe that the Aurora Borealis owes its origin to charged particles coming from the sun and deflected into the earth's atmosphere by the earth's magnetic field. A planet possessing a very great magnetic field intensity would capture these charged particles from a very extended region and might in consequence exhibit an aurora of unusual intensity. It is not without significance therefore, that the intensity of the light coming from Jupiter's surface is known to be greater than can readily be accounted for by mere solar reflection.



Left: Hydrogen spectroheliogram, showing oppositely directed vortices in the two hemispheres. Right: Calcium spectroheliogram covering some region. The magnetic nature of sunspots has been demonstrated by Dr. George Ellery Hale of the Mt. Wilson Observatory



THE THEORY EXPLAINS THE MAGNETIC FIELDS OF SUNSPOTS

ering some region. The magnetic nature of sunspots has been demonstrated by Dr. George Ellery Hale of the Mt. Wilson Observatory



Clearing a runway on the ice for the sealing fleet's airplane

New "Eyes" for the Sealing Fleet

Overcoming Time-honored Tradition, the Aviator Has Become a Valuable Addition to the Sealing Industry

By E. L. CHICANOT

AVIATION in its sweeping, irresistible advance is to be credited with another outstanding victory — the revolution of the Newfoundland sealing expedition. The last bulwarks of staunch conservatism and rigid adherence to tradition have been battered down under the most conclusive demonstration of the practical aid of the airplane to the spring operations of the sealing fleet.

With this frank and general, although somewhat reluctant, acknowledgment from those primarily engaged in the arduous and hazardous business, the operators of the sealing vessels are going the limit in this direction and this year have introduced yet more drastic changes in the order of the expedition, calculated completely to effect the revolution in the manner of conducting the annual hunt, which, up to within a short while ago, had remained virtually unchanged since the first expedition set out from St. Johns in 1763.

C. S. CALDWELL, the Canadian aviator noted for his varied and hazardous flying, after accompanying the sealing fleet on its hunt in northern waters for three years with increasingly apparent success and greater profit to the operators, was asked last spring to make recommendations with a view to the more extensive and effective utilization of the airplane in connection with the annual expedition. As a result of his report it was decided to conduct flying opera-

tions in connection with the expedition from land bases and to secure an improved type of plane for this service. Mr. Caldwell was commissioned to secure a plane and after considerable investigation during the summer placed an order in England. The new adjunct to the sealing fleet has recently arrived on this side.

The machine is an Avro Avian, and was selected above all others, after long consideration given to all pertinent factors, as the best type for the particular purpose. It is a two-passenger machine, although Mr. Cald-

well stalled. The plane is fitted with extra gas tanks so that it can carry sufficient fuel for 500 miles of flying, and is fitted with a special compass. The engine is a Cirrus four-cylinder, air-cooled motor. Altogether, the machine contains what have been decided, after mature deliberation, to be the best features for the unique service. It is considered distinctly superior to the Baby Avro which has been used since flying became a phase of the sealing operations, in that it has a longer cruising range, affords better visibility, and is equipped with one of the most reliable engines in the world.

Plans for the use of the machine of the air in the sealing expedition this year are of a very elaborate nature, and it will have a major rôle such as was quite undreamed of a few years ago when a plane was casually sent out with the fleet.

THE general scheme is, in fact, extremely ambitious and of the most revolutionary order, considering the rabid conservatism which has always characterized sealing operations. Before the advent of winter, land-bases were selected at points on the coast of Labrador, Newfoundland, the St. Lawrence Gulf, and the island of Anticosti. At each, a depot of gasoline of 600 gallons was established. These bases broadly cover the route taken by the seal-bearing ice-floes, the length of the Newfoundland coast. Before winter closed in, everything was in readiness for the new part the airplane was to play in the



C. S. CALDWELL

The Canadian aviator who is largely responsible for the great success of the airplane in connection with sealing operations

well will fly solo as he has done in past years. The plane is fitted with skis to take off from ice and snow, as the entire flying operations will be carried on under the most rigorous winter conditions. For the same reason, special heating arrangements have been in-

sealing operations of the north-east.

The plane will not be altogether a destructive agency; but something more than a spotter and aid to commercial slaughter. Its services are be-

floes move slowly south, he will accompany them, flying from base to base, keeping the sealing fleet, which has not yet set out, fully informed as to ice conditions and the trend of the floes; all stations being in communication with St. Johns by wireless.

At a later date, when after immemorial custom the sealing vessels set out on the expedition, it is anticipated that the information gathered and forwarded will be so complete that the vessels will be able to make directly for the floes by the most expeditious route, thus not only obviating loss of time but considerably reducing the hazard. Until the vessels fill up with their cargoes of skin and oil, the aviator will keep the vessels in touch with seal-laden floes whenever there is necessity.

SUCH drastic innovations in the conduct of the sealing expedition, by a people characteristically conservative to change, and inherently tradition-bound, are not being effected without a good deal of trouble and only after the invaluable aid of the plane in this enterprise has been proved beyond any gainsaying. The old sealer captains, who have participated in the perilous hunt each spring, from their youthful years, were only won over slowly and then forced to their admittances with the greatest reluctance. The lot of the first aviators to accompany the sealing expedition, active men who keenly appreciated the wonderful possibilities of their calling, was not the pleasantest one.

The sealing expedition is possibly the most outstanding feature of Newfoundland life. Every year since 1763 the fleet has set out at the same time; the departure being marked by appropriate ceremony and holiday making. Although in the period when steam vessels have come to supplant the old wooden sailing ships, the method of the hunt, up to a few years ago, remained little changed.

It was very much like a game of hide and seek, the actual locating of the seals being the wildest gamble. After

the ice floes on which the young seals are born break up, they are carried away by the elements in any direction, and so many factors enter into the situation that to determine their trend becomes the merest guess. The vessels make the best of their way north; breasting the icy seas, battling with blizzards, snaking a slow and perilous way among the ice floes. Each captain has his own idea of where the seals might be that particular spring and heads roughly in that direction, making at times only a few miles a day through the ice field.

THE practice was to keep a vigilant look-out from a barrel tower in the masthead, 80 feet above the deck, a seaman scanning the icy prospect with a powerful telescope. The method was a poor one, although the best and only one possible, for indications of the proximity of seals were easily missed. It was, in the first place, not easy from such a distance to determine whether the ice was of the kind on which seals might be found. The small openings in the ice, evidence of the presence of seals, were difficult to detect, while the "whitecoats" or young seals were practically indistinguishable against the icy background. Often vessels would progress tardily for weeks without encountering seal patches, having passed within a short distance of thickly dotted floes.

Possibility of using an airplane in sealing operations was first suggested to the sealer operators when the Baby Avro machine, specially constructed for the Shackleton Arctic expedition, was left behind and remained long unused. After some consideration the



READY FOR THE CHASE

A group of sealers waiting word from their aerial eye, the seaplotting airplane, that a seal herd has been sighted

ing enlisted in the first really serious attempt that has ever been made to stabilize the sealing industry and remove the element of gambling. Mr. Caldwell's work this year will be in the nature of research and discovery.

Notwithstanding the fact that sealing has been carried on off the banks of Newfoundland for 250 years, surprisingly little is known about the seals and their habits, for the reason that never until the era of flying has detailed observation been practicable. Before the fleet leaves St. Johns to take toll, the aviator will make a study of the animals from the time when the old seals come from roaming the ocean to settle on the ice floes until their young are born, and they begin their journey south.

UPON the basis of this information, an attempt will be made to regularize the sealing industry of the future. Anything like system in the past has been quite unknown. Very little information was obtainable as to the spring supplies or the relative severity of the toll taken, it being only apparent that frequently a good harvest was followed by a series of lean years. Upon the facts which the aviator's observation is expected to bring to light, an attempt will be made to regulate the annual slaughter so as to even up the yearly harvests and stave off any possible danger of serious diminution or destruction to the herds.

Starting out, the aviator will leave from the first base at Battle Harbor, Labrador, and fly around until he locates the seals which have come in from the sea to settle on the ice floes and give birth to their young. As the



BRINGING IN THE CATCH

A line of sealers extending across the ice, dragging the seal carcasses, which, when alive, were located by the airplane

owners of the sealing vessels jointly took the very advanced step of purchasing it with the object of using it to scout for the fleet. In 1923 they brought an aviator from England to pilot it, a special aft deck was constructed upon one of the sealers, and, mounted upon this, the plane went out

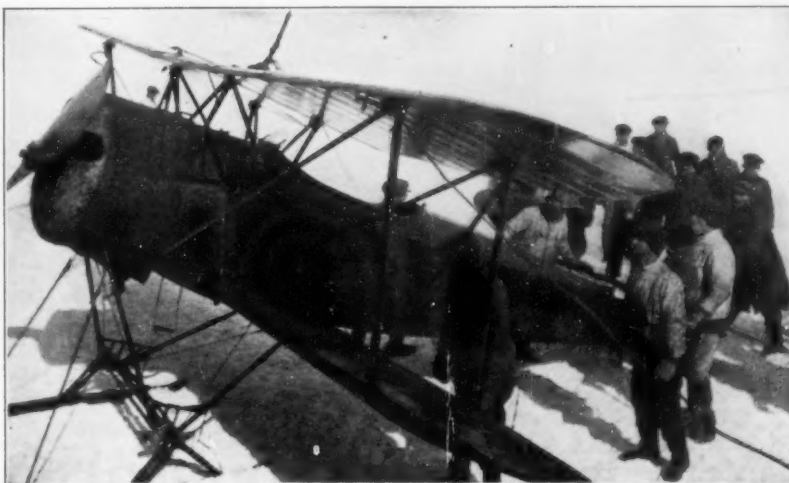
with the fleet to the sealing grounds.

The attitude of the sealers to this sudden invasion can be imagined. The rugged and intrepid fishermen of the island who in the spring make up the crews of the various sealing vessels, who had dared the hazards of the annual expedition from their boyhood, and who were convinced that they knew everything there was to be known about sealing, could not be converted in a day to the effectiveness of so modern a machine, or reconciled to its invasion of a field particularly their own. Their attitude towards its presence was not merely passively skeptical but actively hostile. The captain of the sealing vessel is in absolute command once it has set out from St. Johns, and the result was that the fleet returned to port with the plane still mounted aft, never having been lowered or having made a flight.

IN 1924 the plane was sent out again on another vessel, this time with Capt. B. Grandy, a veteran airman of the Great War and himself a Newfoundland and former sealer commander, as pilot. The same inimical attitude towards the plane was evident, but the expedition started out to be signally unsuccessful and the fleet sailed on day after day without any sign of seals being encountered. The fact that Capt. Grandy was an experienced sealer may have lent weight to his views, but he finally prevailed upon the captain of the vessel to permit him to make a flight. It was the one flight made on the expedition but it was responsible for locating several large patches of seals, one of them being eight miles long and four

and their crews were still most reluctant to admit there could be any improvement in the method they, their fathers and grandfathers had followed, especially as introduced by a layman

St. Johns by the fleet were among the largest of modern years, while it was significant that the outstanding individual catch was always that of the vessel carrying the plane, which had



THE "BABY AVRO" ON AN ICE FLOE

Because of the territory which the sealing plane covers, the regulation landing wheels have been replaced by the skids shown, making operations on ice safer and more practical

and landlubber. On this expedition, only again because much time was passing without trace of the seals being encountered, the aviator induced the captain to have the plane lowered to the ice.

HE made two flights. The first proved very rapidly, by the formation of the ice, that the fleet was proceeding steadily in the wrong direction. Upon this being corrected, a second flight was responsible for putting the vessels in connection with the seals, of whose proximity they had no suspicion, after 10 minutes in the air.

In 1926 and 1927, Mr. Caldwell again accompanied the sealing fleet, achieving greater success and more fruitful results with greater utilization of the machine. The same practice as in previous years was followed, the plane going out mounted upon the deck of one of the sealers. When required for flight, it was lowered upon an ice floe, where a sufficiently large space for a take-off had to be cleared. This was probably the most hazardous phase of flying ever undertaken in Canada, the position of the pilot being desperate, in fact practically hopeless had he been forced to descend upon an ice floe when out of sight of the sealers. The floes are ceaselessly moving and even should his plight and position be ascertained it would have been almost impossible for one of the vessels to get up to him through the ice field in time to be of assistance.

Fortunately no such mishap occurred and the flights were unqualifiedly successful in every particular. The aggregate catches brought back to

been able to take first advantage of its services and act upon the information it secured. Catches and profits, in which captains and crews share, were eloquent testimony to the practical value of the plane in operations, and effectively swept aside any remaining vestiges of opposition, though old-timers continued to view with sadness the new era it was ushering in. The conversion was generally complete when the decision was arrived at to give the plane the major rôle it occupies in the expedition this year.

THE manner in which it is projected to use the plane this spring and in future years will effect the most complete revolution in the long established manner of conducting the seal hunt, putting an ancient industry, which has suffered little change down the years, on a modern basis, and all to the advantage of the industry and its followers. The availability of the plane on the expedition has already very materially reduced hazards which are very great and always imminent, and it will further do so since vessels will steam for the floes together instead of setting out independently.

This should reasonably result in the more rapid gathering of the harvest of peltry and oil together, with greater revenue for operator and employee. Above all things, the plane is to make a serious attempt to stabilize the industry and ensure its preservation to Newfoundland for all time. Conviction that it can do this, on the part of those who so intimately know the problems, is as great a tribute as has ever been paid the airplane.



LOADING

A group of seal carcasses on a floe, ready to be hoisted aboard the sealing vessel

miles wide, containing upwards of 50,000 seals.

In 1925, C. S. Caldwell was engaged to fly with the expedition. The first difficult barrier had been broken down but the captains of the sealers



Courtesy Mt. Wilson Observatory

LOOKING DOWN ON SOUTHERN CALIFORNIA FROM MT. WILSON OBSERVATORY

The great observatory, comprising numerous structures, is perched on top of Mt. Wilson, several thousand feet above Pasadena, which shows in the background. This month the author's article was written at the Observatory

Another Astronomical Puzzle Solved

The Problem of the Nature of the Peculiar "Planetary Nebulae" Gives Way to the Modern Astrophysicist

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

A FEW months ago we told the tale of the identification of "nebulium" and explained how this supposedly unknown element turned out to be nothing else than oxygen and nitrogen. But the full story was not then available for publication. The recent appearance of Dr. Bowen's paper upon the subject releases another chapter which may now be summarized here.

The gaseous nebulae are of two kinds. The largest and most conspicuous, like the familiar one in Orion, belong to the "diffuse" group and are as chaotic in appearance as could well be imagined. But the majority are smaller and much more regular in outline, appearing in a small telescope as little roundish green disks specifically resembling the outer planets Uranus and Neptune. For this reason they have received the rather unfortunate name of "planetary nebulae," although they are really utterly unlike the planets.

ALMOST all these "planetary" have central stars, sometimes very faint but always showing up much more strongly on photographs than with the eye. It follows that these central stars must be

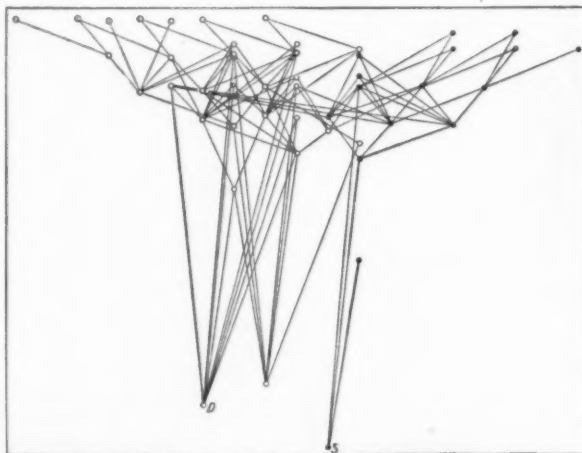
very hot, and their spectra confirm this since they belong to Class O which contains the very hottest stars of all. The diffuse gaseous nebulae too (as Hubble has shown) are associated with hot stars often of the next cooler type, Class B, but nevertheless with a surface temperature of fully 20,000 degrees.

There is conclusive evidence that these nebulae are not really self-luminous. They act as transformers, not sources of energy, and are fed in some way from the nearby hot stars. It

appears to be that in the parts of the nebulae nearest the "exciting" star, the gas is more powerfully stirred up to shine. When a planetary nebula is photographed with a spectroscope, but without a slit, each spectral line gives a separate image of the nebula, and these are of different sizes. The hydrogen lines and the ultra-violet line at 3727 give the largest images; the green nebular lines give smaller images; the helium lines still smaller ones, and those of ionized helium and doubly ionized oxygen very small images. The smallest image of all, according to Bowen, probably arises from trebly ionized oxygen.

THE order of size of image closely parallels that of the ease of excitation of the lines as measured by laboratory evidence. The hydrogen spectrum, for example, can be excited under suitable conditions by a potential of about 14 volts; helium requires about 25, and ionized helium or doubly ionized oxygen 55 volts.

The exciting power of the influence of the star therefore diminishes as the distance increases. This is true, too, in their regular gaseous nebulae. In the Orion neb-



ENERGY STATES, IONIZED OXYGEN ATOM

Taken from an analysis of the spectrum by Fowler, Bowen and the author, and reproduced from the January issue of the SCIENTIFIC AMERICAN, page 26

ula, for example, the green lines which demand a rather high excitation are strong in the central region; while in the outer parts they fade away, leaving the more easily excited hydrogen lines still visible.

These facts have been known for some years. It is their explanation by Dr. Bowen which belongs to the latest scientific news. No finer example of the way in which modern physical conceptions aid the astronomer could be desired, and it is worth the small trouble to follow it in detail.

LET us recall that an atom may exist in many different energy states (as illustrated in the diagram which is here reprinted from the January number). To each one of the many permissible transitions between these states (represented by the lines on the diagram) corresponds the possibility of the emission or absorption of light of a particular frequency or number of vibrations per second. If exposed to radiation of all sorts the atom will absorb these kinds of light, and to each process of absorption will correspond a particular change in the orbits of the electrons within the atom.

But another possibility exists. By feeding enough energy into the atom, one of the electrons may not merely be shifted into a larger orbit but sent flying away—the atom may be ionized. This too can be done by absorption of light, but here there is an important difference: the liberated electron may leave the atom with any amount of energy, large or small. Hence, light of any frequency can do the work of ionization, provided only that it be capable of providing enough energy necessary to pull the electron out of the

region of continuous absorption covers short wavelengths only. For hydrogen, for example, it begins at 911 angstrom units, in the "vacuum region" when the observer must put his whole spectroscopic outfit in an airtight case and pump out all the gas inside. For ionized atoms the limits are still farther out—ionized oxygen, for example, absorbs only wavelengths less than 353 Å, and for doubly ionized oxygen the limit is at 225 Å.

Light of such very rapid vibrations would be given out only by an excessively hot body. But we know of no reason why some stars should not be exceedingly hot. Their directly measured temperatures of 25,000 degrees or so are probably far from the possible maximum. Suppose, then, following Bowen, that such a very hot star with a temperature of perhaps 100,000 degrees is surrounded by a mass of gas (for simplicity we may consider oxygen alone). Almost all the radiation from this star will be of very short wavelength and be powerfully absorbed by the gas, using its energy in pulling electrons from the atom.

WHEN a hydrogen atom has lost an electron it is put out of business, but an oxygen atom which has lost one can lose another and then a third, and so on. Close to the central star where no previous absorption has weakened the light, oxygen will lose four electrons but no more, since the star, hot as it is, gives out little or no light of wavelength short enough to remove a fifth. The loose electron will fly about and after an interval, perhaps of weeks, each one will be captured again by an atom which will drop back to the trebly ionized state and emit the corresponding spectrum, including the line which gives the smallest of all the nebulae images.

The very short wave radiation will be used up in this process, and farther from the central star it will fade out, leaving radiation which can pull out the third electron from an oxygen atom but not the fourth. In this region, farther from the center, the lines of doubly ionized oxygen will appear. Still farther out, by the same token, will be found lines of the singly ionized atom. The key idea is the gradual depletion of the outgoing radiation from the hot central star, the shortest waves being absorbed first, then the longer ones. Whatever sorts of atoms may be present in the gas, they will respond similarly to this varying type of radiation. Lines which are hard to excite will appear only near the center, and those of easier excitation will give larger images.

The great strength of the "forbidden" lines of which we spoke last January still need some explanation and this, too, is forthcoming. The electrons liberated from the atoms will

usually be ejected at high speed. When such a fast moving electron meets another atom it may recombine with it. But another possibility exists. There may be an "inelastic" collision in which the atom gains enough energy to shift it from one of its possible states



A TYPICAL DIFFUSE NEBULA

This is known as the "North America" nebula, for reasons which are self apparent

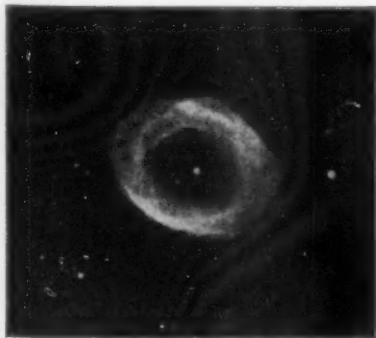
to another, and the electron flies away again—but with reduced speed.

Consider now our diagram of energy levels. The electrons, as calculation shows, will rarely have enough energy of motion to change the atom from one of the low states marked S, P, D, to one of those at the top of the diagram. But they will very often be able to shift it from the S state to the P or D. And an atom in one of these states is ready to emit the characteristic nebular lines and will do so if the gas is sufficiently rarefied.

BOWEN shows good reason to believe that a large part of the energy which is originally absorbed from the star's radiation will go into the motion of the electrons and ultimately appear as radiation of the nebular lines. Indeed, when all the details are considered it is found that the greater part of all the energy absorbed by the gas in the extreme ultra-violet will, after various transitions, come out in the bright line which we can actually observe.

An excessively hot star will give out far more radiations in the very short wavelengths than in the visible region. If it stood alone in space the latter alone would be perceptible and we might call it a faint star. But if it stands in a mass of gas, most of this short-wave radiation will be transformed into visible light and we will see the star surrounded by a nebula, apparently much brighter than the star itself, from which it derives its energy.

The agreement of theory and observation is admirable in all points.



RING NEBULA IN LYRA

Planetary nebulae are round like this, but without the central hole in the "doughnut." They have no connection with planets

atom. Expressed in other terms this means that for longer wavelengths or smaller frequencies the atom will absorb light of only certain definite sorts, giving dark lines in the spectrum.

But beyond a certain limit all frequencies will be absorbed and the spectrum will show a continuous wide, dark band. Even for neutral atoms the

Geophysical Prospecting*

Scientific Methods by Which Trained Geologist-Technicians Are Aided in the Search for Hidden Minerals

By A. S. EVE, D.Sc.

Director, Department of Physics, McGill University

and D. A. KEYS, Ph.D.

Associate Professor of Physics, McGill University

MINING men who have long left school and college, who have forgotten much of the physics that they formerly knew, and are not familiar with the advances that have since been made are today perplexed to know how much value to attach to modern methods of detecting ore bodies, and also salt domes that may have oil on their hidden slopes. Meanwhile, attractive and well-written pamphlets are issued which set forth a large number of methods employed by scientific men working with geophysical companies that have headquarters in the leading financial centers of the world.

Are these methods sound? Which of them are of any use anywhere? Are they first cousins to the divining rod? Which method, if sound, will best suit local needs?

To make better speed, let us go back a little. During the World War the detection of submerged submarines was

considered. Experiments showed that submarines, steel vessels, had magnetic properties. They were made of different metals and each behaved like a battery in sea water; also, they were capable of reflecting sound waves directed toward them. A number of ingenious devices based on these physical properties were contrived, and technique was constantly being evolved and improved.

THE analogy between hunting submarines under water and ore bodies under ground is close. Detection of either depends on the difference between the properties of the body and of the surrounding medium. In ore bodies this difference is sometimes magnetic, particularly when iron ore is present or when magnetite is distributed throughout some particular material the detection of which is desired.

Under other conditions a sulfide ore body may have electro-chemical properties, the result of oxidation by surface water, and then the system behaves like a battery.

In addition to these separate magnetic and electrical properties, there are the combined electro-magnetic effects, common to all bodies but varying for different kinds, which depend on electrical conductivity, dielectric constant, and magnetic permeability. Hence there arises a variety of possible detectors, some of them using direct or continuous current and some of them alternating current with a wide range of frequencies extending upward through the audible to radio (wireless) frequencies, and involving principles of induction and capacity.

Important differences in density lead to gravitational methods which use either a pendulum or the torsion balance.

Again, where there are materials differing in density and in elasticity, the velocity of the sound or of the shock waves varies with the different materials, and detection may be made by seismic methods; that is,



Courtesy Swedish-American Prospecting Corporation

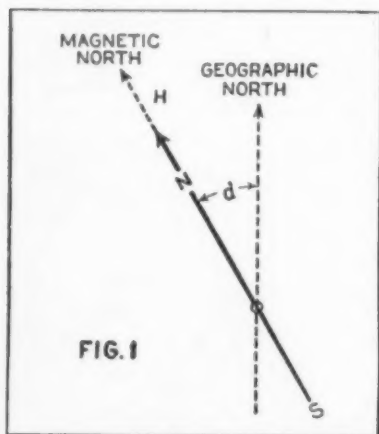
FIELD INVESTIGATIONS

The electro-magnetic method of Sundberg depends on the secondary magnetic field caused by the ore bodies and other conductors

the waves caused by an explosion, refracted by or reflected from various strata, are detected by a 'quake recorder or seismometer.

This report is written for geologists, mining engineers, and others who desire a concise and simple explanation of the more important physical principles underlying each of the various methods of geophysical prospecting that at present are being applied by scientific institutions and private companies.

THE different methods described are all based on recognized physical principles, but the interpretation of the results obtained from such surveys depends, of course, on the knowledge and experience of the geologists and physicists consulted. The best methods to use at any particular place will depend upon the geological structure of the region and the type of mineralization one is looking for. Experience will be an important factor in reaching a decision. The reader should note that geophysical methods of prospecting are in reality an aid to the geologist in supplementing his knowl-



MAGNETIC NORTH VARIES

The angle d , between true north and magnetic north, is called the angle of declination

a grave and difficult problem. When the submarine was in motion, noises made by the propeller could be heard through the help of underwater microphones, called hydrophones; but when the submarine was at rest beneath the surface, sight and hearing failed, and other methods of detection had to be

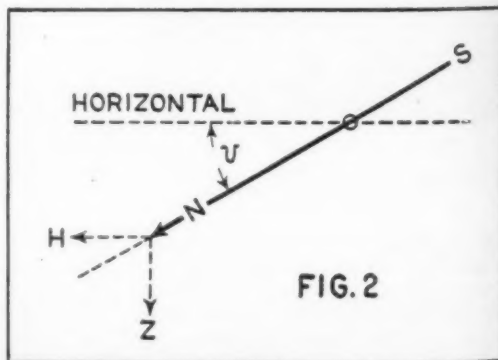


FIG. 2

USING THE DIP NEEDLE

Diagram showing dip v , horizontal component H , and vertical component Z , due to the earth's magnetic field

*Reprinted by permission, from United States Bureau of Mines Technical Paper 420. All illustrations redrawn.

edge, and are in no way a substitute for such knowledge.

For the purpose of this report, the subject has been divided into four separate groups. Under each group the main topics are briefly described with the physical principles involved, and a diagram is given illustrating simple theoretical cases. In practice the results obtained are much more complex.

It is hoped that this publication will meet the needs of those seeking a simple explanation of the physical principles that underlie the various methods of geophysical prospecting and will also dispel from the minds of others the belief that the methods are enveloped in mystery.

Magnetic Methods Magnetometers

THE earth behaves as a great, but rather irregular, magnet. Steel bodies when magnetized retain their magnetism; hence we have the compass needle, and the dip circle or inclinometer. A coil of wire rotated in the earth's field generates a current, hence the earth inductor. These fundamental properties can be applied in a variety of ways, so that there results a multitude of magnetometers of different types.

Some ores are like steel in that they are not only magnetic but tend to retain their magnetism unless they are unduly jarred or heated. Such magnetic permanence is shown by magnetite (Fe_3O_4) and pyrrhotite (Fe_7S_8). Other ores are like soft iron in that they can be readily magnetized in a magnetic field but do not retain their magnetism. Remove the cause or rotate the body and their magnetism disappears or changes its polarity or direction. Ores that behave like steel are termed "attractorily" and those like soft iron "retractorily" magnetic bodies. These names are somewhat clumsy and misleading and may safely be discarded.

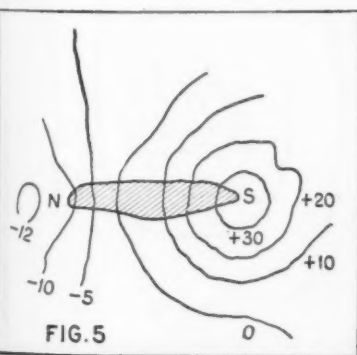


FIG. 5
PLAN OF ISODYNAMIC LINES

Along each line the vertical component Z (intensity of magnetic force) is constant

torily" magnetic bodies. These names are somewhat clumsy and misleading and may safely be discarded.

The direction and intensity of the

magnetic field vary from point to point on the earth's surface. If a small compass needle capable of rotating about a vertical axis is set up at any place, it will not, in general, point toward the geographical North Pole, but rather toward a point called the magnetic north. The angle between the true north and the magnetic north is called the variation of the compass or the angle of declination, d . (Figure 1.) The strength of the earth's magnetic field acting in a horizontal plane along the direction of this magnetic needle is called the horizontal component of the earth's magnetic field at the point and is usually designated by the letter H . If now another type of magnetic needle (Figure 2), capable of rotating about a horizontal axis through its center of gravity, is placed with its axis of rotation perpendicular to the direction of the first compass, this needle will dip or point downward into the earth. The angle which the needle makes with the horizontal is called the angle of dip or inclination i , and the intensity of the

places where the resultant magnetic intensities are the same, give the so-called isodynamic lines.

A mass of magnetic ore disturbs the magnetic field locally, and by making a

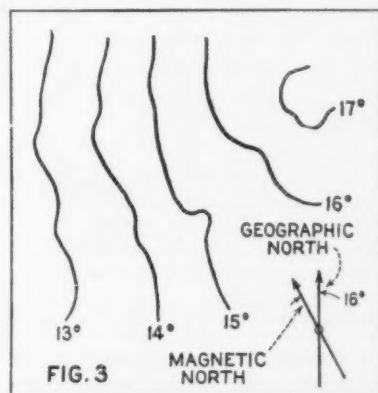


FIG. 3
ISOGONAL LINES

Isogonal ("equal-angled") lines connect the points of equal deviation of the needle

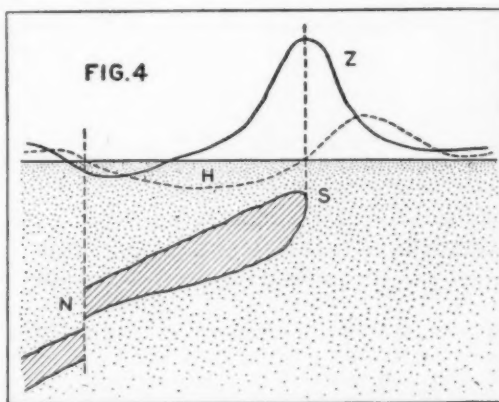


FIG. 4
CHANGES IN HORIZONTAL COMPONENT

This profile shows how a magnetic ore body will increase and decrease the vertical component over its respective ends

vertical field acting on the needle is called the vertical component of the earth's magnetic field; this component is usually designated by Z .

The angles of declination and inclination and the corresponding values of H and Z have been determined for many years at various places scattered over the earth's surface. The angles are usually obtained by using sensitive magnetic needles as indicated above and the values of H and Z are determined by making observations on the period of oscillation and the deflections of a small magnet at the given place. Points at which the deviation of the compass is the same are joined, forming a line called an isogonic line; thus the surface of the earth has been mapped in a general way, showing the isogonic lines. (See Figure 3.) In the same manner a map may be made that gives lines of equal dip (isoclinic lines); so also another set of lines, passing through

magnetic survey with such magnetic needles or magnetometers as are mentioned above, these variations from normal are discovered. By an analysis of the results of such a survey, the presence, extent, and approximate depth of certain deposits can sometimes be determined. This type of geophysical prospecting is the oldest, but it is only suitable for detecting the presence of an abnormal excess or deficiency of magnetic material in the earth.

Magnetic Variometers

With the magnetic variometer one measures variations in the intensity and direction of the earth's magnetic lines of force rather than the actual values. For such a purpose variometers may be classified into two groups; the instruments of one group are of the type called horizontal variometers because with them the variations in the horizontal component H are measured over the area under investigation, and those of the other group are known as vertical variometers because they measure the variation in the vertical component Z .

THESE devices depend upon the fact that as the intensity of the magnetic field increases or decreases, the direction of the magnetic needle (or needles) changes slightly, and by observing these alterations one finds the variations in Z and H . The diurnal variations caused by other sources, such as magnetic storms, must be allowed for by obtaining from a neighboring observatory the variations noted there or by keeping one variometer stationary while others are

moved about the region being surveyed and then using the stationary instrument for determining any variations in the earth's magnetic field during the survey. In this way only those varia-

is rotated at constant speed in these two directions give a measure of the value of H and Z , respectively.

The region is thus surveyed, appropriate corrections being made for any temporary disturbances in the field that are of cosmic or terrestrial origin, and the results are plotted on a map as usual. The variations caused by local deposits containing magnetic ores in excess or deficiency from the normal are thus revealed.

Many types of instruments to be used in connection with the three methods described above have been developed by various prospecting firms

be produced as shown in Figure 6, where the dotted line indicates the plumb line as if the mountain was absent, and the full line and bob show the actual plumb line, the displacement being grossly exaggerated.

Similarly masses of high density underground will cause a sideways displacement of the plumb bob toward them and away from the lighter masses. Over dense bodies the actual value of g may be locally increased. (See Figure 7.)

THE actual value of the attractive force (designated by g) exerted on unit mass by the earth may be found from the period of oscillation of a simple pendulum, which consists essentially of a small sphere suspended at the end of a fine thread of known length. When the spherical bob is displaced slightly from its position of equilibrium it oscillates back and forth with a constant period. If the period and length are accurately determined by experiment, the value of g may be calculated.

The value of g depends upon the nature of the ground in the neighborhood of the pendulum; and as ore bodies usually are denser than ordinary soil, the value of g will increase slightly over a deposit of heavy ore. Similarly when the subsoil consists of material having a density less than the average density of the soil the value of this attractive force is a little less. These changes in g are so slight in practice that the ordinary simple pendulum will not detect them.

The simple pendulum has long been

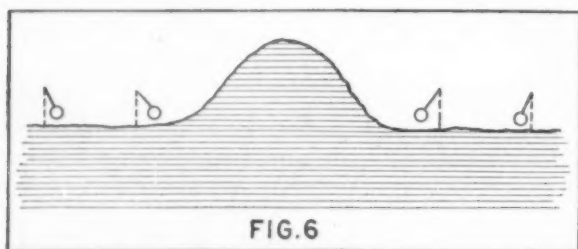


FIG. 6

HOW A MOUNTAIN ATTRACTS THE PLUMB BOB

The vertical dotted lines show how bob would normally hang. As the mountain is approached the bob is increasingly displaced toward it

tions due to the nature of the formation underground are used, and a map constructed from the readings indicates the location of any disturbing field due to mineralization. A theoretical case is depicted in the two drawings, Figures 4 and 5, which show an iron ore body underground and the effects observed above. When the variations in Z and H are plotted along a straight line crossing the field, the vertical component Z reaches a maximum at a point directly over the south magnetic pole of the deposit (Figure 4); its value is below the normal at a point over the North Pole. The fluctuations in H are not so simple, but may also be used for determining the extent and depth of the deposit. The contour map of the variations in Z from the normal value, measured in arbitrary units, is shown very roughly in Figure 5 for the same ore body. Thus, by obtaining the proper data, plotting the maps, and interpreting the results, the variometers may be used for locating magnetic ore deposits or regions in which the normal amount of magnetic material is lacking.

Earth Inductors

An earth inductor consists of a coil of wire which is rotated in the earth's magnetic field in much the same way as the armature of a dynamo is rotated between the poles of magnets. The earth's field induces a current in the coil; this current is measured by a galvanometer or other suitable means, and its strength is proportional to the strength of the field in which the coil rotates.

THE coil is set to rotate in a direction cutting only the horizontal component of the earth's magnetic field and then in a direction cutting only the vertical component. The strengths of the currents generated when the coil

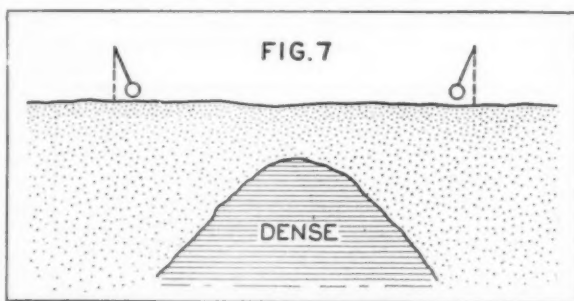


FIG. 7

EFFECT OF A DENSE MASS UNDERGROUND

The plumb bob is displaced just as in Figure 6, even though the attracting mass lies beneath the surface of the ground

and scientific institutions. A design has also been evolved for a single instrument to permit measurement of all three values— H , Z , and the declination in succession.

Gravitational Methods Pendulum Methods

The value of the constant g , which is the acceleration, due to the earth's attraction and rotation, of any freely falling body at a stated place, has been for years measured by finding the time of swing of a Kater pendulum of known dimensions. The value of g decreases with height above sea level and also decreases with depth below ground, in each case by simple laws formulated by Newton.

In the neighborhood of mountains, hills, or large boulders, deflections may

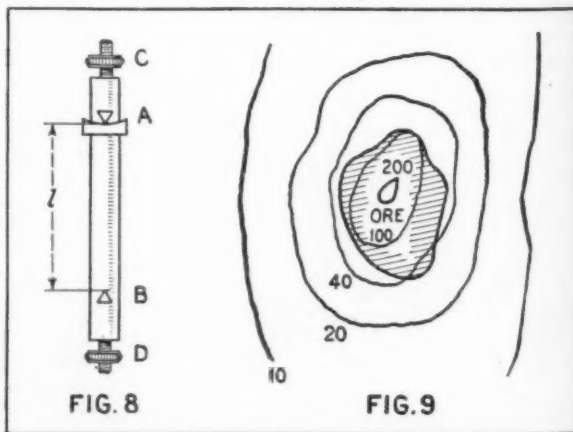


FIG. 8

FIG. 9

PENDULUM GRAVITATION METHODS

Left: The Kater reversible pendulum. Right: Isogams over a dense ore body; along each isogam the earth's attraction is constant

superseded by more sensitive and accurate devices. One of these is the simple form of reversible pendulum shown in the accompanying diagram.

(Figure 8.) The rigid bar is first supported at *A* and its period of oscillation accurately determined. It is then reversed, supported at *B*, and its period again found. The distance between the knife edges *A* and *B* and the position of the two masses *C* and *D* may be adjusted until the pendulum has very nearly the same period when supported on *A* as when supported on *B*. If the distance between *A* and *B* is known and the necessary corrections for temperature, pressure, et cetera, made, the value of *g* may be obtained from such readings to an accuracy of three parts in a million.

IN surveying by any pendulum method the values of *g* are determined at various points over the locality under investigation; a map showing the lines of equal gravitational force is then drawn. A theoretical example is shown in Figure 9, where the increments of *g* are plotted in arbitrary units. The values of *g* will increase over a heavy ore deposit, and from the contour of the lines of equal *g* ("isogams") the presence of ore may be inferred. Figure 10 gives a profile view of the readings in the same hypothetical example. Here we see that the value of *g* increases as we pass over the deposit.

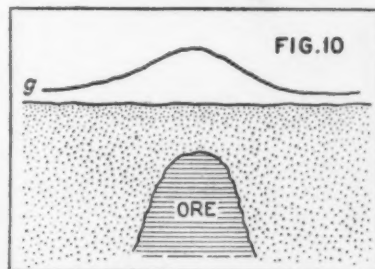
In a region in which the subsoil is lighter than the normal value the value of the gravitational force becomes less. This would happen if one passed over certain types of salt deposits. The pendulum may therefore be used for determining variations in the underground structure, but the poor sensitivity of the method has caused more accurate and more sen-

Torsion-Balance Methods

In exploring a region one does not have to know the actual value of the gravitational force; a knowledge of how this attraction varies from place to place over the area under investigation suffices. Any instrument that will measure accurately very small changes in *g* would therefore have immense value to the geologist in determining the underground structure. Such an instrument was first devised and used by Eötvös and although many modified forms are now employed for prospecting, the principle underlying their action and use is the same and may be stated briefly as follows: Two small equal gold or platinum masses are supported at the ends of a light horizontal beam. The beam is supported at its center by a fine wire, *G*, as shown in Figure 11. One of the masses (*A*) is placed at one end of the arm and the other (*B*) is hung about 60 centimeters below the other end of the arm.

Suppose there is a dense mass of ore at *P*, causing a force *F*₁ to act on *A*

sary corrections have been made for surface irregularities, temperature, et cetera, are calculated the value and direction of maximum horizontal change in the gravitational force and the direction of no change. This procedure is repeated for various points on



PROFILE OF FIGURE 9

Profile *g* shows the increase of gravitational attraction on a unit mass over a dense body

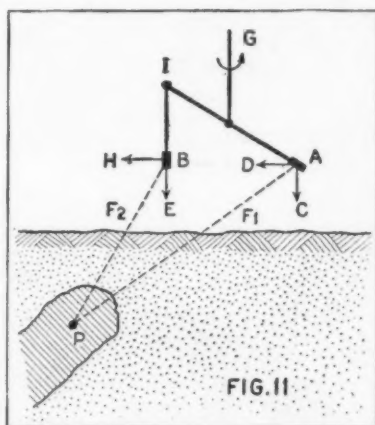
the surface of the area being investigated, and when the results are mapped it may be possible to deduce the position of an ore deposit, faults, or salt domes. The method is extremely sensitive, changes of the order of one part in a million million being detectable. Calculation of the results from the readings and interpretation of the results are both difficult, but the instrument has been applied by its inventor to geological surveying and has yielded a vast amount of new information; it has also been used for several years by various companies and scientific bodies in prospecting in level stretches of country, more especially in the oil regions.

THE actual instrument has three casings to shield it from drafts, wind, and sun, and a tent or hut is also necessary, for temperature effects are very troublesome. Not only are the calculations difficult, but the corrections are often important.

In order to hasten observations, two balances are sometimes combined in one instrument, thus halving the time essential for taking readings; for compactness Z-shaped balances have also been designed. (See Figure 12.)

After the results from numerous well-selected stations have been plotted the final interpretation presents a difficult problem to both the geologist and the physicist. Nevertheless, more than a hundred of these costly balances have been purchased for oil prospecting in North America.

The remainder of the paper will be published in the June issue. The reader's attention is called to an editorial on page 400, from which it will be seen that the geophysical methods are of value only in the hands of men who, in addition to being geologists, understand thoroughly, in theory and practice, the technique of the method used.



EÖTVÖS TORSION BALANCE

These formerly cost 18,000 dollars, but the price is now only about 7000 dollars

in the direction shown and a slightly larger force, *F*₂, to act on the nearer mass *B* in a slightly different direction. Each of these forces may be resolved into a vertical and horizontal component, *C* and *E* being the two vertical components and the two horizontal components, *D* and *H*. Now as *H* will be a little greater than *D*, there will be a resultant twist or torque on the arm *AI* causing it to turn until this torque is balanced by the torsion of the wire *G*. The amount of twist given to the wire is measured by a suitable optical method, sometimes visually but more often photographically. The vertical components *C* and *E* do not tend to produce any rotation around *G*. A series of six readings with the arm *AI* in different directions is required at each place to complete a usual set of observations. From these data for a given station, after all neces-

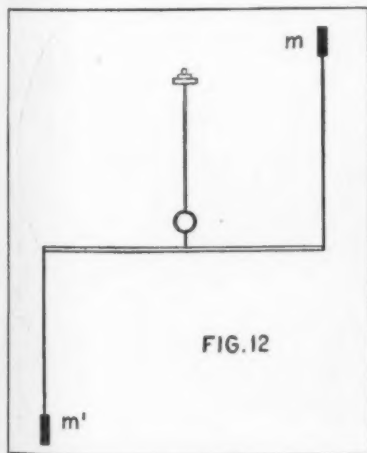


FIG. 12

THE Z-TORSION BALANCE

Two balances are here combined in one instrument, effecting a double saving in time. The torsion balance with its housing is about seven feet in height and three feet in diameter, and requires several hours for each set-up and observation. The work proceeds slowly

sitive methods, as outlined below, to be used.

Archery—The New-Old Sport

Primitive Weapon, Now Used in Competitions, Is Made in Cave Man's Style, But By Modern Methods



BOW AND ARROW FACTORY

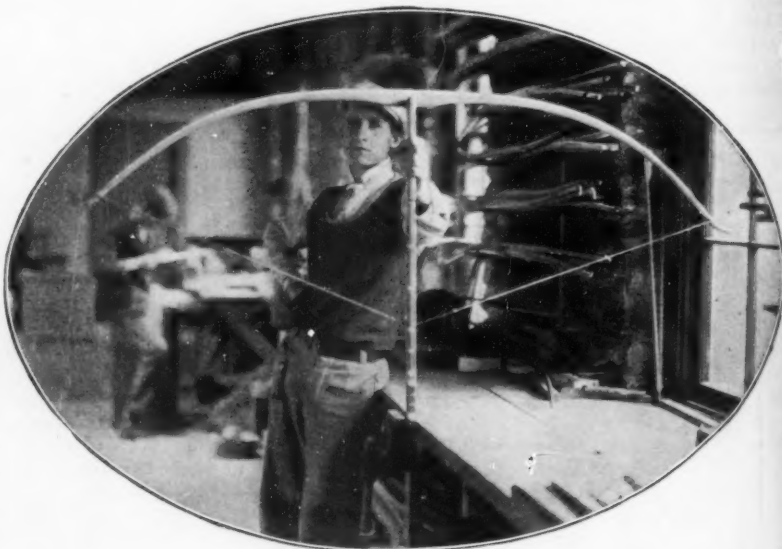
The Guild Shops of the Archers Company at Pinehurst, North Carolina, where every craftsman is an archer. A group of them is shown here in a sporting event after working hours. The sport has taken

such a hold on sportsmen that standards have been set to govern the exact size of targets, rules have been made for all classes of competitions, and even old English archery games have been revived



MAKING A BOW

The modern bowyer employs the same simple tools used by primitive man, with the exception that his are of steel instead of flint. The photograph above shows the workman shaping the rough stave into a bow, his tools being a spoke shaver, a small plane, a scraper, and a file. Prior to this operation, selected wood is stacked and dried in such a way as to minimize warping, the bow being cut with the wood grain



TILLERING THE BOW

The photographs on this and the opposite page show some of the steps in the making of modern bows and arrows for sport and for hunting. The one immediately above shows the method of testing the bend of a bow. A bowstring is lightly looped over the ends, the bow is placed on the form, and the string brought down to one of the notches. The curve is observed, the bow is removed and scraped in the stiff places, and the operation repeated over and over until a perfect result is obtained. Modern bows, as will be noted, have a stiff hand grip instead of a true curve as in the old style, this feature allowing the bow to be shot with less jar. It is interesting to note that the making of bows and arrows very nearly assumes the role of an industry, due to the fact that more and more of these implements are being used throughout the world in sporting circles and for hunting



SEASONING BOWSTAVES

Future bows—cut strips of lemonwood and lemonwood logs as they come from Cuba—stacked for seasoning. For months they remain in a cool place and then are moved to a warmer location



DEER KILLED BY ARROW

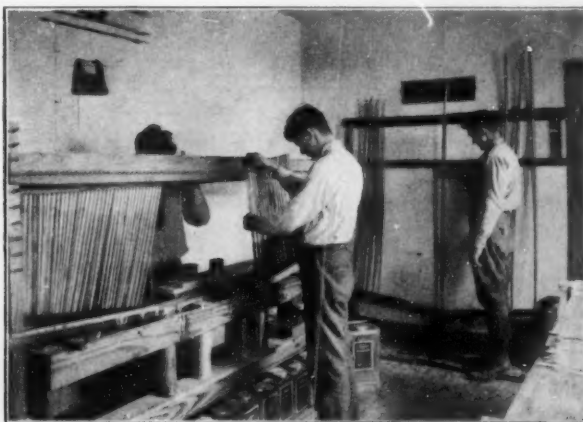
The arrow passed entirely through the deer but was replaced to show location of hit



Courtesy John G. Hemmer, Pinehurst, North Carolina

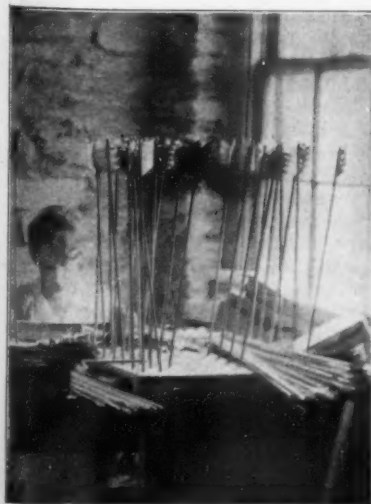
ARROW-MAKING

Four steps in making a perfect modern arrow. From left to right: cutting the notch in the arrow for the bowstring on a special grooving saw; sand-papering the arrow while it is spun rapidly in a chuck; char-hardening the point over a flame; and rounding the tip by grinding on an emery wheel. Point is usually put on after sand-papering



DIP PAINTING

In this room the finished equipment is coated with a glossy lacquer by dipping. The man in the background is dipping a bow into a lacquer-filled four-foot tube set into the floor, half the bow being dipped at a time and then set to drain and dry. The arrows are dipped in the same way, except that shorter tubes are used as shown in the foreground

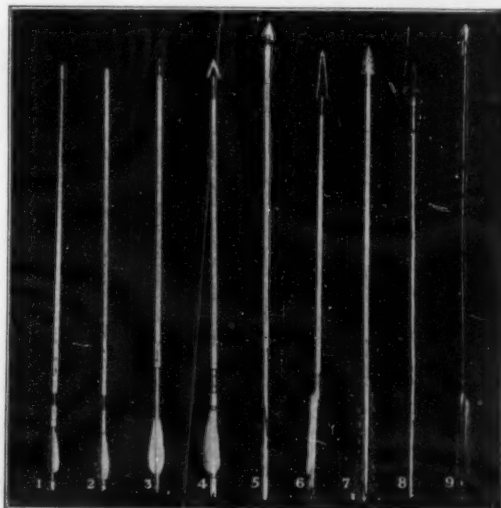


FLETCHING

In fletching—attaching the flight-guides—an expensive waterproof glue is used to fasten three feather vanees at equal distances around the shaft. The three pieces must come from the same side of the bird to prevent wobbling of the arrow in flight

ARROW TYPES

Ancient and modern, from left to right: 1—Footed, with shaft of red deal; 2—Newly developed with head of aluminum-magnesium alloy; 3—Modern hunting, broadhead; 4—The arrow with which deer was killed, (see above); 5—Shaft made by Chief Standing Deer; 6—Sioux arrow said to have been used against Custer's men in the Battle of Little Big Horn, and which has a metal head; 7—Indian arrow with obsidian head; 8—Highly decorated Turkish armor-piercing arrow; and 9—A Chinese armor-piercing arrow similar to those used against the American Marines during the Boxer Rebellion. Note comparative lengths



One-piece Automobile Bodies

Wooden Frame Dispensed With; Body Shell Entirely of Metal, Lock Seamed and Spot Welded



Photographs courtesy Edward G. Budd Manufacturing Company

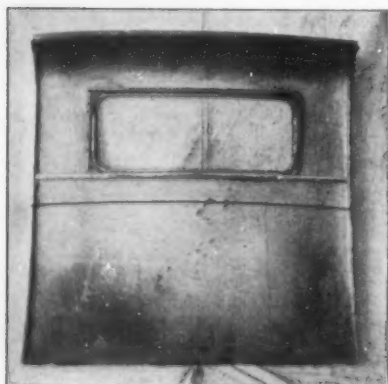
CAR INTERIOR

Silence is a feature of these all-steel bodies. Door sill has been eliminated, and roof has cross members. Flanged body bolts to chassis



ASSEMBLED SECTIONS

Front view of completed interior showing dash and two front doors. To lighten the construction, the interior of box sections are perforated

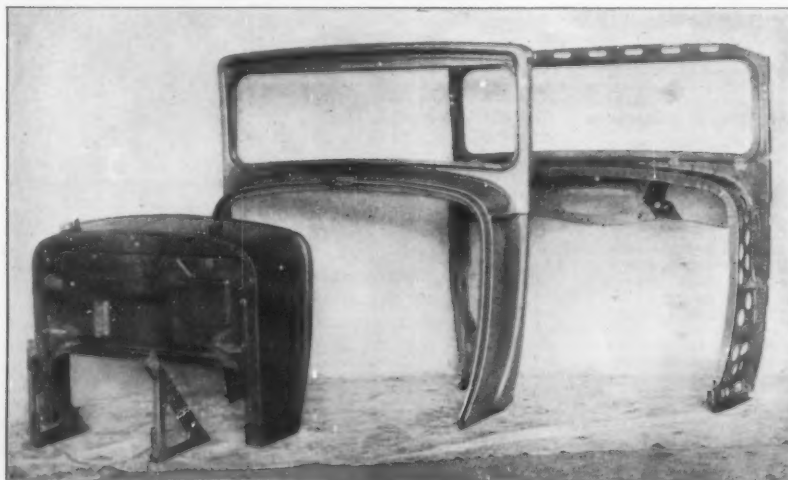


BACK SECTION

The curving of this large, one-piece section made it unnecessary to use box sections for strengthening. When the seams of this section are locked and spot-welded, the result is a rigid, exceedingly strong body that needs no inner frame of wood

FRONT UNIT SECTIONS

Cowl, exterior section, and box section of the car front. This is a good example of the nesting of inner and outer units as it is featured throughout. It shows also the perforation of the inner box section, which has been done to decrease weight. In this case it will be noted that the instrument panel has been put to work to strengthen the front assembly against racking. Heretofore the instrument board has served no useful structural purpose, but has always been the source of many undiscoverable noisy squeaks



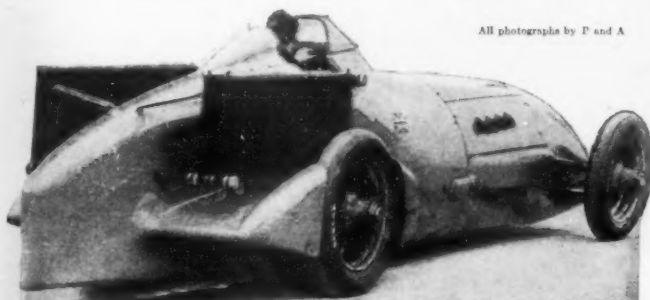
SO many changes have been made in automobile body designs since the appearance of the first crude "buggy with an engine under it" that the child has outgrown the parent. Engineers are constantly working on automobile designs, not merely to add beauty, but to increase stability and comfort of modern cars.

Recent developments along this line are represented in the new practice of making the body and chassis one integral unit. This is done by making the body not a wooden framework sheathed with metal, but by stamping out the body in large sections—larger than ever before thought possible—and spot-welding the locked seams together; utilizing an inner and an outer shell, pressed to shape, for pillars, et cetera; and bolting the whole to the frame.

The chassis frame is widened and the body sills and cross-bars have been dispensed with; the number of body parts has been greatly reduced; and the center of gravity lowered. Both height and weight are saved, and besides providing more space for the interior of the car, the new method gives maximum strength for a minimum of weight. It is stated that the chassis-and-body, single-unit method of construction will allow development of more beautiful lines, will give much greater stability and better riding qualities, and will minimize rattle. The photographs on this page show some of the stamped metal parts used by one manufacturer this year in the construction of stock cars by this new plan.

Speed Demons

Remarkable Speed Record of Last Year is Broken



All photographs by P and A

CAPTAIN CAMPBELL'S "BLUEBIRD"

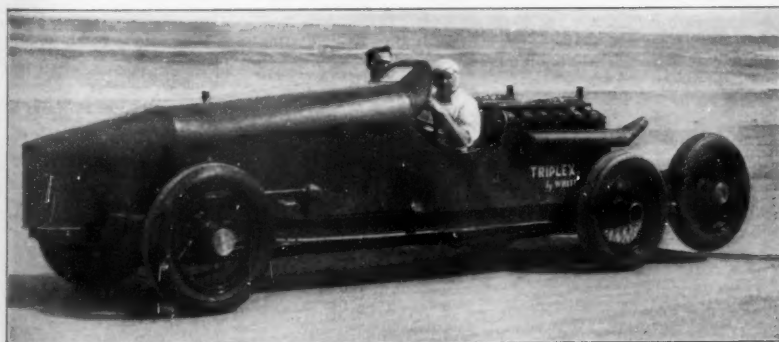
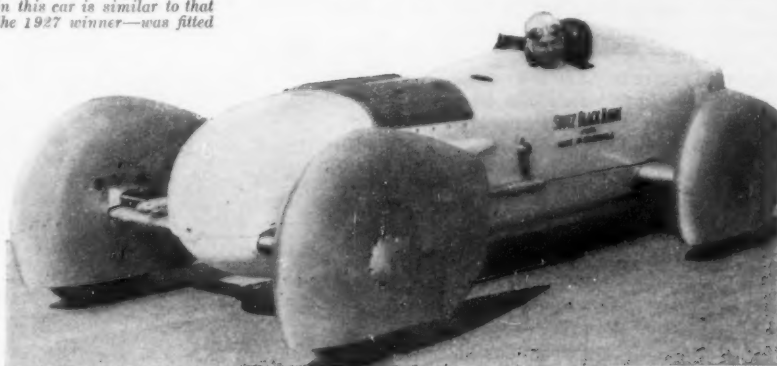
The English "mystery car" in which the English driver raced over the hard-packed beach sands of Daytona Beach and set a new world's record for automobiles of over 206 miles an hour. The motor used in this car is similar to that with which the British Schneider Cup airplane—the 1927 winner—was fitted

LOCKHART'S "BLACK HAWK" ▶

The specially built car in which the American racer took a dive into the water while making a speed of 225 miles an hour. In designing this car, a wind tunnel was used to study air resistance. Hence streamlined body and wheels

J. M. WHITE'S "TRIPLEX" ▼

The automobile that was not allowed to run in the official competition. It is equipped with three 12-cylinder motors having a total of 1500 horsepower. Driver Ray Keech is shown at the wheel of this powerful car on the beach sands



SPEEDING at a terrific rate in what has been termed "storms of their own making," two automobiles, specially constructed and equipped with powerful motors, early in February attempted to break the record for earth-bound vehicles set by Major Segrave on Daytona Beach, Florida, in 1927. These contenders for the title also ran on that beach, and one of them, Captain Malcolm Campbell, of England, in his *Bluebird*, beat Segrave's record of over 203.5 miles an hour by setting up a new record of 206.956 miles an hour. The other contender, Frank Lockhart, came to

grief when his Stutz special, *Black Hawk*, raced into the sea while unofficially making 225 miles an hour after a four-mile start. J. M. White of Philadelphia had expected to run his *Triplex* but his car was ruled out of the race by the American Automobile Association because its hastily installed reverse gear did not meet the association's requirements. It is thought by many that if Lockhart's car had not swerved into the sea he would have gained for America the coveted record.

Captain Campbell, after making the new record, is reported to have said



FRIENDLY COMPETITORS

From left to right: Captain Malcolm Campbell, English racer who brought the *Bluebird* to Daytona Beach, Florida, drove it himself, and retained the record for England; Frank Lockhart, the American whose attempt to set a new record in the *Black Hawk* ended in a disastrous spill into the sea; and J. M. White of Philadelphia, whose *Triplex* was ruled out of the official competition

that "there is no limit to speed." To some, this is doubtful because of the slowness of physical response to exterior stimuli. They believe that when a second's swerve means a traveled distance of hundreds of feet, the human brain cannot telegraph its message to the hands fast enough to prevent disaster. The mechanical limitations of such a high speed car are also necessarily great. The question of land speed seems to resolve itself into a determination of man's endurance and the strength of the cars he can build.

In the effort to reduce the air pressure downward on the nose of the machine and the upward rush under the tail, the automobiles built so far for these races have been streamlined as much as possible, as may be seen from the photographs, and tires were made to resist the tremendous centrifugal force and the generated heat. Besides being a major sporting event, therefore, these races have afforded the scientific world a study of human endurance and man's ability to withstand the shocks that occur while he still retains conscious control, and have given automotive engineers something new to think about in the way of mechanical possibilities and limitations.

World's Largest Vehicular Tunnel

*Built on Land, Towed to Place, and
Sunk, Section by Section*

By J. BERNARD WALKER



TOWING A SECTION

It took three tugs three hours to tow this 5400-ton segment 10 miles across the bay

THERE is nearing completion between Oakland and Alameda, California, an under-water tunnel which is attracting much attention; not merely in the locality where it is being built but throughout the engineering world. The local interest is due primarily to the fact that it will provide a greatly needed improvement in the transit facilities between two large and rapidly growing centers of population, which are separated by an estuary of San Francisco Bay.

Hitherto, communication has been by way of a swing bridge, built over 30 years ago, in 1895. This structure was condemned by the War Department in 1916; but the order for its removal was stayed, at first on account of our entrance into the World War, and later to await the completion of the tunnel.

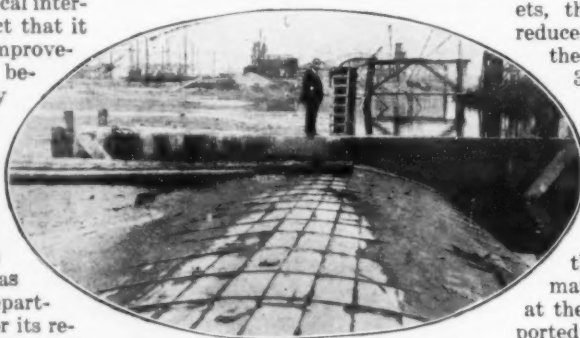
Outside interest in the estuary tunnel is due mainly to the novelty and difficulty of the methods of construction, and also to its unprecedented diameter. The largest existing subaqueous work of the kind is the Holland Tunnel below the Hudson River, whose diameter is 29½ feet. The estuary tunnel exceeds this by seven and one half feet, with an outside diameter of 37 feet. The walls are 30 inches in thickness and they are built throughout of concrete, heavily reinforced with steel.

IN cross-section, the estuary and the Hudson tubes are similar, each consisting of three separate longitudinal compartments, the lower forming a fresh-air duct, the upper a foul-air duct, and the center a roadway which measures 24 feet from curb to curb. In the center are two tracks, the top of the rails being flush with the paved roadway surface.

The total length, including the approaches, is 4436 feet. The length between the portals is 3545 feet, and of this 2436 feet was built in 12 precast,

concrete segments, each 203 feet in length, which were poured in a drydock, floated, and towed to the site where they were sunk with great care and precision to position in a deep trench which had been dredged across the estuary.

Now it will be understood that since the weight of each of these massive segments was 5400 tons for a length of over 200 feet, the question of providing a satisfactory foundation, that would



JOINT BETWEEN SEGMENTS

A shore segment during low tide. The wall at its farther end is a joint. Note size

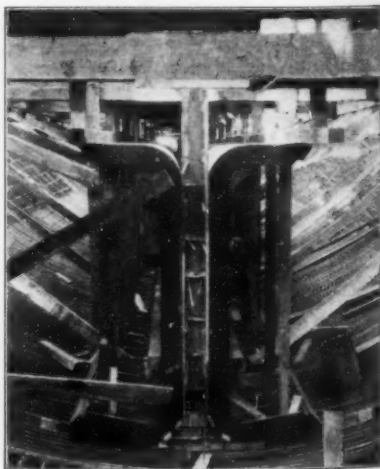
be so permanent as to remove all anxiety as to future settlement, was of first importance. It is true that, although the weight, unloaded, was 5400 tons, the displacement was 7261 tons, and therefore the ultimate load on the foundation could be determined by the engineers. Nevertheless, it was desirable to so support the tube that vertical, and even lateral, bending stresses should be reduced to a minimum; and it was this consideration which led to a radical change in the original plans.

As first designed, the entire base of the cut was to be covered with a tremie slab, two and one half feet thick, and the weight of the segments was to be transferred to this by concrete brackets two and one half to five feet thick, spaced at intervals of 19 feet, four inches along both sides of each segment. The plan as adopted dispensed with the bracket-and-slab method, except at the abutting ends of the segments, and the whole tube was laid upon a bed of sand, interposed between the tube and the bottom and sides of the trench.

This change of plan presented many advantages. It dispensed with the difficulty of laying a thin slab in flowing tidal water, 100 feet deep; it substituted for intermediate brackets a continuous support, solid and uniform; it made it possible to place a uniform, unbroken, waterproof covering over the whole surface of the tunnel.

FURTHERMORE, by the elimination of the heavy concrete brackets, the weight of each segment was reduced. In dredging the great trench, the upper material, to a depth of 35 feet, was taken out by a suction dredge, and the remaining material by a clam shell dredge, a total of some 850,000 cubic yards being thus removed. The bed of sand above referred to, was laid throughout the greater part of the trench, where the underlying material was firm; but for 400 feet, at the Alameda end, the tube is supported on piling reinforced by tremie concrete, four feet thick, 65 feet wide, and 400 feet long, the piling being driven in rows, transverse to the axis of the tube, the space between rows varying from three and one half to seven and one half feet.

Before removing a segment from the drydock in which it was cast, each end was closed by a steel-and-timber



ROADWAY SUPPORT

Reinforcement and forms for center wall to support roadway. Duct is for fresh air

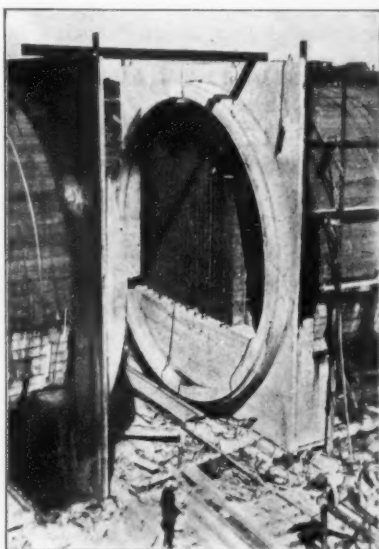
bulkhead, consisting of 24-inch, 85-pound I-beams, closely spaced, over which was laid a deck of six-inch by eight-inch wood sheathing, which was calked. Provision was made for access to the interior through a manhole, fitted with a 30-inch steel pipe of such length that its top would project well above water after the tube was lowered into place. Pipes were also provided, through which ballast, in the shape of sand and water, could be loaded into the segments to sink them to place.

It must be remembered that, when empty, each segment drew 26 feet and had a displacement (or weight) of 5400 tons; and when the slight negative buoyancy necessary for sinking was secured, it drew just over 37 feet with a displacement of 7261 tons. The sequence of operations was as follows: First, dry sand, as ballast, was loaded into the segment to the extent of 950 tons. This was spread over the surface of the roadway slab to a depth of three and one half to four feet. Then the segment was towed to position above its final resting place and securely moored. Then water was siphoned into the segment from the estuary and sufficient sand added to float it with one and one half feet of the crown of the tube showing above water. Finally an additional load of about 150 tons was added to give the tube sufficient negative buoyancy to put a slight load on the end bridles by which the segment was lowered into place from floating derricks.

The work of lowering the massive segments accurately into place, so that they would be aligned with erectness, was no simple task. For sighting, when the segments were submerged, two lofty steel alignment masts were erected at each end of each segment and braced securely in place. They were so set that, when a segment was correctly in place, they would be vertical and in line with the masts on the adjoining segment.

Where it is considered that the side thrust on a segment, due to the tides

in the estuary, might reach a maximum of 80 tons, it will be realized that to hold and control the great tube, as



FOR FLOATING SEGMENTS

Strong bulkheads of calked eight-inch planking and 24-inch I-beams were built at ends

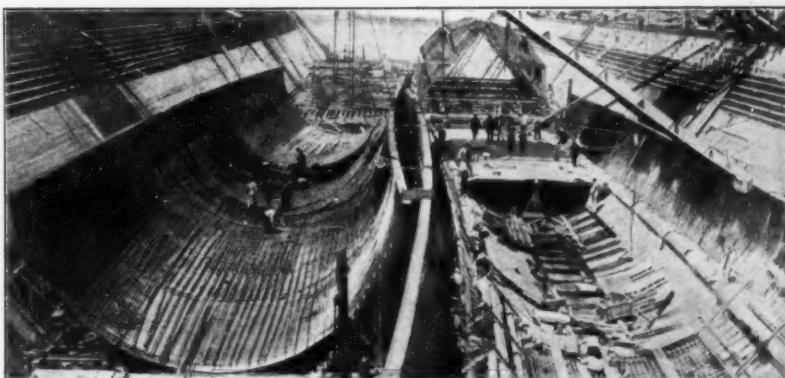
it was being lowered, called for very careful provision. It was done by

means of an elaborate system of wire cables, extending from the segments and controlled by hand winches carried on heavy pile dolphins, which had been driven into the estuary for this purpose. This took care of all horizontal adjustments. Vertical movements were controlled by means of bridles of six and one half inch wire rope, passed around each end of the segment, and controlled through a system of blocks on a floating crane at each end. The total emergency lifting capacity was 400 tons.

THE system of ballasting above described, maintained the vertical load well below this maximum. In forming the joints between abutting ends of the tube, the end surfaces were roughened, the steel reinforcement rods were cleaned and lapped and the closing ring of concrete was poured. Although the maximum depth in which diving operations were carried on was 100 feet, the actual sinking and setting was usually accomplished in less than two hours.

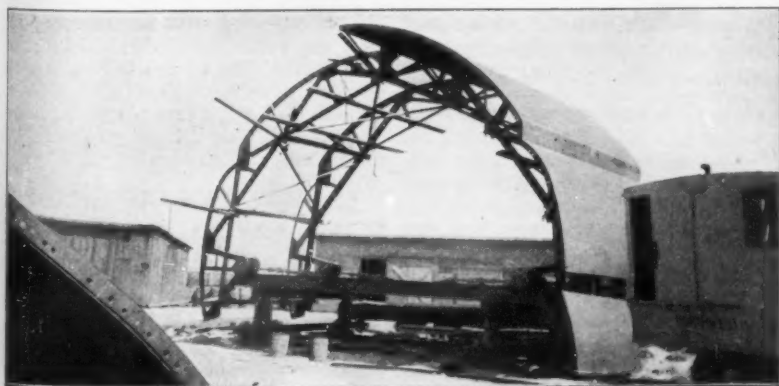
In view of the great size of the units, the depth to which they were lowered and adjusted, and the fact that the cost was about one half of what it would have been had the shield method been adopted, great credit is due to the engineers who designed and carried through the work. The tunnel was built for the County of Alameda, with George A. Posey as chief engineer, and Lochiel M. King as engineer of construction.

It is expected that the tunnel will be completed and ready for formal opening almost coincident with the publication of this issue. The performance of its various units, and of the tunnel as a whole, will be studied carefully as the tunnel goes into operation. This will offer a splendid comparison of the construction methods with the more expensive one followed in building the Holland Tunnels, and the result will be, no doubt, a determination of the method that will hereafter be used for similar tunnels.



BUILDING SEGMENTS IN DRYDOCK

The inert, or lower halves of two segments, being built in drydock. Note the intricate mass of reinforcing rods necessary, and the great size of the half tubes as compared to the workmen



UPPER ARCH FORMS

Because of the great diameter of the tunnel—37 feet—elaborate steel forms were necessary for building the upper half of the segments. This photograph shows a typical steel form section

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygeia

The Danger of Beauty Surgery

ON January 17, a young woman consulted a surgeon in Chicago who specializes in beauty surgery with a view to having treated a burned place on her shoulder. According to her story, she talked to him at the same time about some bowing she thought she had in her legs, and paid him 800 dollars in advance for operations on the shoulder and to correct the alleged bow in the legs. Subsequent treatment and infection made it necessary to remove the legs in order to save the young woman's life. The X-ray picture indicates that the bones were not bowed, but as straight as such bones are in normal people. Moreover, the operation performed consisted merely of sawing through the large bone of the leg without touching the small bone. Thus the small bone acted to hold the fragments of the large bone in place. Obviously the result of such an operation would be negative so far as concerned the configuration of the limb. A suit for 200,000 dollars in damages has been filed against the surgeon.

Carbon Arc Radiation and Infant Health

SCIENTIFIC considerations demand exactitude of observation. When methods of measurement are applied to problems of health, great difficulties develop because of the variations between human beings in their factors that may be associated with development of disease. The general claim has been made that irradiation of the body with ultraviolet rays from a carbon arc or a mercury-vapor lamp helps to prevent colds and respiratory infections. Indeed, it has been urged that the frequency of such infections in the winter is due in part to a deficiency of sunlight in the winter months.

Drs. L. H. Barenberg and J. M. Lewis of the Home for Hebrew Infants in New York made a careful comparative study of two groups of infants as to the incidence of respiratory infection, one group being regularly exposed to the rays of a carbon arc and the other being permitted to grow without the exposure. In spite of the

systematic exposures to the radiations, no comparative diminution in the incidence of respiratory infections was noted in the infants treated for a period of three months. During the first six weeks, growth in weight and height was greater in those infants exposed to the rays than in those not exposed. However, during the second six weeks, growth was less in those exposed to the radiations. The amount of red coloring matter in the blood was maintained at a constant point in those receiving the rays, whereas a fall of 12 percent occurred in those not receiving the rays.



AN UNSUCCESSFUL OPERATION

X-ray photograph of both legs on which an operation was performed by a "beauty" doctor, supposedly to correct bow legs. The large bone in each was cut part way through

The carbon arc exposures did not result in tanning of the skin to any great extent, whereas exposure to the sun's rays for a few days brought about tanning. Obviously there are differences between the rays of the sun and those of either the carbon arc or the mercury-vapor lamp.

The results of Doctors Barenberg and Lewis cannot be taken as proving conclusively that the ultra-violet rays may not be of service in building resistance against respiratory disease.

However, they represent a definite attempt to put such investigations on a scientific basis.

The Birth Rate for England

STATISTICS for 1927 indicate for England and Wales the lowest birth rate ever recorded since the establishment of registration. The death rate was slightly higher than for 1926. The infantile death rate was equal to that of 1923, which was the lowest on record up to that time, indicating a saving of lives. Indeed, the infant death rate for 1927 was 69 as compared with a rate of 154 in 1900, and of a very high rate of 163 in 1899. The decline in birth rate is giving great concern to English sociologists who emphasize not only the danger of a falling population but also of the one-child system. The latter is serious for the psychological health of the people.

Hunger Pains

WHEN a person becomes hungry he develops pains due to contractions of his stomach. Similar pains occur in case of ulcer of the stomach or upper portion of the intestines. There are two prevailing views as to the causes of these pains: first, that the acid digestive juices of the stomach irritate the ulcer—this view is supported by the fact that the pain can be controlled by eating or by taking alkaline substances; second, that the contractions are strong enough to produce pains even in a healthful person and that the presence of an ulcer causes irritation and stimulation of the nerves in the region of the ulcer. Obviously such studies are important in determining the salient points in the diagnosis of this condition.

Grapefruit as a Patent Medicine

THE campaign of the orange growers and grapefruit growers of California, Texas, and Florida for increasing consumption of these foods is a most meritorious one. The citric fruits are valuable in that they contain vitamins and in that they tend to counteract acid conditions of the body. On the other hand, one group of grapefruit growers in Florida in a very small

district has come forward with the claim that the grapefruit in that district differs from every other kind of grapefruit and is of special value in the treatment of diabetes.

In the development of this notion, two Michigan physicians printed an article in the medical journal of that state. Now they come forward with the proposition of establishing a sanatorium in Florida for the treatment of diabetes and high blood pressure with the grapefruit mentioned, and with the statement that the grapefruit will be sold only to the patients of the sanatorium or on a physician's prescription. They even plan to put the grapefruit up in cans for use in the months when it is not available. The *Journal of the American Medical Association* points out that there is not the slightest scientific evidence that any kind of grapefruit has any curative qualities in diabetes, in hardening of the arteries or in high blood pressure.

The Brain of Lenin

PROFESSOR O. VOGT, director of the Emperor William Institute for Brain Research in Berlin, was called to Russia by the Soviet government and asked to undertake, in a laboratory established in Moscow, a complete study of the brain of Nicolai Lenin. The brain was subdivided in 31,000 separate specimens, all of which were examined under the microscope after staining.

Professor Vogt gave out a preliminary report of his observations, which appears to be an attempt to ex-

plain scientifically the abundance of ideas and their wide range and the capacity for quick thinking said to have been possessed by Lenin. Most of these conclusions are based on the large number of paths proceeding from the pyramidal cells of the brain and the

sufficient to make the difference between life and death. Dr. Julius H. Hess has invented a hand ambulance for transporting a premature infant to the hospital. The hand bag is of leather and steel construction, 23 inches long, 14 inches wide and 17

BABY AMBULANCE

Showing the construction of the ambulance for premature babies. The thermometer D indicates the temperature within. Vent G admits fresh air which passes to the heating unit C. From here it circulates up through the ambulance and out through vent H. Both air vents have adjustable shutters. Temperature control is by a thermostat, adjusted by turning key P. A window at I permits observation of the infant within, and the interior may be illuminated by a light not shown. A red light B indicates that the heating equipment is functioning.



marked development of the pyramidal cells themselves.

Unfortunately, American neurologists who are accustomed to thinking scientifically will consider the evidence extremely slight and will be inclined to doubt that the observations prove anything, except that Lenin's brain had well developed pyramidal cells and many paths leading from them.

Tuberculosis Among Young Women

THE craze for reduction in weight has apparently resulted in a considerable increase in the number of cases of tuberculosis in young women applying to dispensaries in various large cities. Dr. S. Adolphus Knopf of New York City indicates that the death rate for young women with tuberculosis in New York City has declined less than in any other part of the state, and that the rates for women are much higher than those for men. In Baltimore and Cleveland, similar figures were observed. Doctor Knopf recommends annual periodic physical examination, education as to proper posture, deep breathing, and adequate diets as some of the most important hygienic principles to be followed in lowering the number of cases of tuberculosis and the death rate in young women.

An Ambulance for Premature Babies

THE most important step in keeping alive a child born before it is fully developed is the maintenance of its temperature. Sometimes the mere fall of temperature between the transportation of the child from the place where it is born to the hospital may be

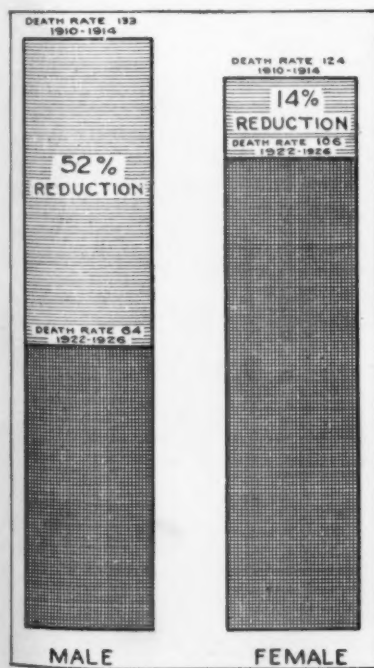
inches deep. An even temperature is maintained by electric heat with thermostatic control, a composite heating unit permitting the use of current either from an ordinary socket or from an automobile battery.

The Bathroom Heater as a Patent Medicine

IN addition to exploiting the ultra-violet invisible rays for such effects as they may produce, some manufacturers of electrical apparatus sell devices for producing infra-red or heat rays. In many instances these have about the same efficiency as a one dollar bathroom heater, consisting merely of a coil mounted in a reflector. The effects are heat effects pure and simple, such as can be achieved by electric toasters and incandescent lamps.

Ultra-violet Rays Revivify Animals

IN London Zoo, difficulties in rearing monkeys, lizards and other tropical wild animals are being overcome by the use of ultra-violet rays. Not only are animals exposed to incandescent lamps with silica bulbs but cages are lighted with 300-watt lamps of thin glass. According to Dr. Leonard Hill, these lamps are placed above perches, and surrounded by wire screens to prevent breakage. As a result, tropical lizards have begun to feed; monkeys bask in the light; animals which have not previously bred in captivity now do so. The difficulty in the way of continuous use of ultra-violet for human infants is development of proper screening to control rays, limiting them to those of value.



TUBERCULOSIS DEATH RATE

This comparison is from the age group from 15 to 25 years. Cleveland; white

Where Nature Imitates Man

Usually, Man Imitates Nature. In Copying Prehistoric Implements of Flint, Natural Forces Imitate Man's Handiwork—Not Too Closely, However, for the Expert to Distinguish Them

By J. REID MOIR

Fellow of the Royal Anthropological Institute of Great Britain and Ireland

(Drawings by the Author)

The Controversy Became Warm

AMONG anthropologists there has been a prolonged and bitter controversy concerning the origin of certain flints found in England—flints which, if substantiated, would be by far the earliest known evidence of man, stretching toward 1,000,000 years in antiquity. Mr. Moir, the author, has been at the center of that controversy, for it was he who discovered the flints. It took him years to attract sufficient attention to them so that professional anthropologists finally sent a committee to examine the evidence and pronounced it genuine. Only a very few still hold out against the decision rendered, claiming Mr. Moir's finds can be duplicated by jingling flints together in a sack, or in a flint ballast highway where vehicles exert pressure. But Mr. Moir, an expert worker in flint, easily distinguishes these.—*The Editor*

IN the May, 1927, number of the SCIENTIFIC AMERICAN, I was able to give some account of the little that is known about the origin of flint, the remarkable material from which prehistoric man made so many of his implements and weapons, and I now wish to say something about the various ways whereby it is possible to fracture this rock.

The question of flint fracture is of great interest to scientific people and of vital importance to those who have chosen to follow upon the often dim tracks of our prehistoric ancestors. Without a knowledge of this subject no archeologist can be truly said to know his business, but in spite of this undoubted fact it is only of late years that the question has been taken up with any approach to seriousness.

IN human affairs, the less that is known about any particular matter the more acrimonious are the discussions about it, and this certainly holds true as regards flint fracture, for there has been no question in prehistoric archeology more debated, nor which has raised greater animosity among those who study this subject. When, years ago, I started investigating certain ancient and supposedly pre-human deposits in eastern England, I found myself, very quickly, in complete disagreement with those who regarded the flaking on the flints I had found, as of natural origin. And when I

asked them to prove to me that their contention was correct, I found they were unable to do so. But, when, in turn, I began to question myself and to ask whether I could prove my views to be sound, I soon discovered that, like my opponents, this was beyond my powers. I accordingly decided to carry out forthwith experiments in the fracture of flint, in order to see if I could establish my contention on a really scientific basis, and the work I undertook I found to be of surpassing interest. For, not only did I succeed in convincing most archeologists of the fact that

the flints discovered are undoubtedly shaped by man, but I was able to gain some insight into the strange ways in which flints fracture, and also to distinguish between specimens broken by natural and by artificial means. A KNOWLEDGE of this matter is as necessary to an archeologist as an acquaintance with the various types of wood—their hardness, grain, and so on—is to a carpenter; and the former, possessed of this knowledge, can not only admire the beauty and form of a flint implement, but can see exactly how it was made by the craftsman of many thousands of years ago. Let us then go into this question a little more closely and see what nature and man can do in the way of breaking flints.

As will be seen, there are various manners in which this may take place, each having its own characteristics, and it may be said that these characteristics are an outward and visible sign of an inward and bodily tendency of the flint to fracture in a certain way under certain conditions. These methods by which nature breaks flints are (a) by blows, (b) by pressure, and (c) by the effects of heat and cold. She may rattle flints along in a rapidly running stream, or waves may hurl stones against others on a sea beach, or flints may fall from cliffs upon others lying below.

In each of these three cases the collision of the specimens may produce

flaking along their edges, and at other relatively weak places. But, in the case of the flints that are fractured under water, the flakes removed are not generally very large, as the liquid in which they are immersed acts as an agent of retardation, greatly lessening the force of the blow. This may be realized when one attempts to flake flint with a hammerstone, with the hands held under water. Further, the flakes removed by nature in such surroundings are short and squat, and differ very markedly from those resulting from intentional human blows. (Figure 1.)

THE flaking produced by natural pressure is often of quite another kind, and may deceive some archeologists who are unable to distinguish between it and the work of man. The conditions under which natural pressure operates in fracturing flints are by no means common, but in places they do occur and give rise to innumerable examples of flaked stones. Such conditions may be found when a bed closely packed with flints, in many cases in contact with each other, rests upon a hard resistant rock of one kind or another and is overrun by a mass of strata of considerable thickness (Figure 2). The weight of the overlying beds—especially if any movement on their part takes place—has the effect of flaking a certain number of the flints in the bed underneath, and in this case pressure is the agent of fracture.



NATURE'S IMITATION

FIGURE 1: This would deceive the average person, but a flint worker would detect immediately its accidental origin

A similar state of affairs may exist beneath a glacier, and the pressure of the moving ice produce flaking of the flints subjected to the force in operation. But the fractures induced by pressure do not in the mass assume the same forms as those which are the result of human blows with a hammerstone, and when a sufficiently large series of each kind can be examined, given the requisite knowledge, it is not difficult to differentiate between them. The general appearance of pressure flaking is its "smoothness," which is due to the fact that when two flints are in contact under this force, very thin flakes are being moved, so long as the pressure and the conditions enabling it to fracture the flints are in operation. Now, in flaking produced with a hammerstone it is impossible to hit the flint so close to the edge as to produce such thin flakes, and thus specimens shaped by pressure and percussion are fundamentally different in technique and appearance.

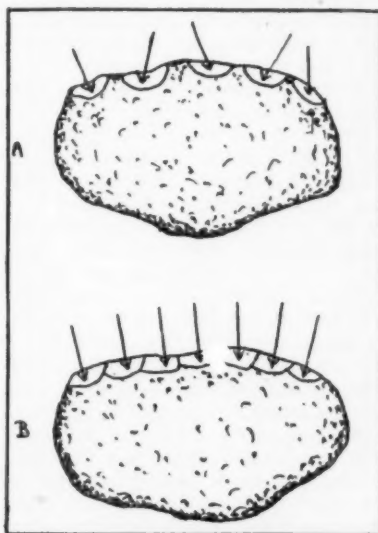
TOWARDS the close of the stone age, man certainly employed pressure with a stone or a bone point in flaking certain implements, but these are usually of very elaborate forms, such as has never been produced by natural pressure.

But, in addition to the inherent peculiarities of the type of flaking produced by unguided percussion and pressure, an examination of a series of flints fractured by these means will show that the flake scars observable upon their surfaces have been removed from many directions (Figure 3), while the specimens themselves are of meaningless forms such as would be almost useless as implements or weapons. On the other hand, flints shaped by man have their flake scars removed in an orderly sequence and their forms are such as could be used effectively in many ways.

Although, as has been shown, nature has flaked and is flaking flints by percussion and pressure, yet these examples are not comparable in number with those which she breaks by means of thermal changes. There is no doubt that the great fracturing forces in nature which break up flints are heat and cold, and that these carry out their work continually. In certain parts of the world where desert conditions ob-

tain, and where a very hot day is often followed by a rapid temperature fall when night comes on, the flints which have stored up heat during the day contract so rapidly as to give rise to an almost explosive disruption which scatters the fragments of the stone over a considerable area. The fractures produced by such means are usually of rectangular form and of the same order as those induced in a flint when it is placed in a fire.

ANOTHER type of fracture produced by thermal changes takes the form of the lid of a pot and is, in fact, known as "pot-lid fracture." The flakes so removed exhibit, usually towards the center of the fracture surface, a small protuberance surrounded by concentric ripple marks marking the spot where the original point of disruption is situated. Although some doubt may occur in deciding whether any single flint of a primitive type has been flaked by human agency or by natural percussion or by pressure,

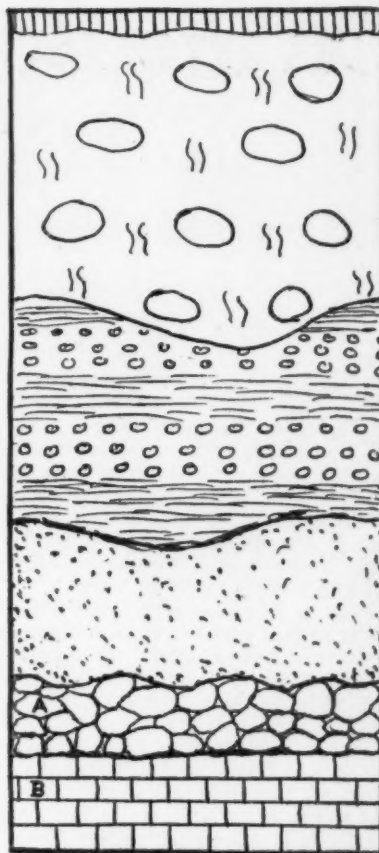


HOW MAN DOES IT

FIGURE 3: A is naturally flaked—force exerted from various directions. B is humanly flaked—force exerted in a uniform direction by blows from a hammerstone

there is no difficulty in arriving at a decision as to whether a stone owes its fractures to thermal effects, as these are so very typical.

In my prolonged researches into this matter, not only does it appear that each type of fracture produces a different kind of flake scar, but I have been impressed by the seeming difference in the appearance of the surfaces given rise to by percussion, pressure and by thermal agency. It is possible that the velocity of the wave of fracture differs in each case, and that while percussion acts quickly, pressure is less rapid in its action, while thermal breakage is still slower. Although the difference in the surfaces produced by



HOW NATURE DOES IT

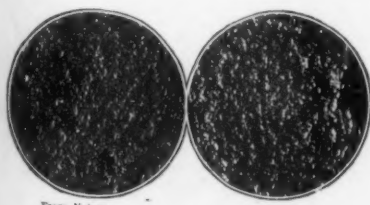
FIGURE 2: A bed of flints at A rests on hard rock B, with pressure exerted from above

percussion and by pressure are not always easily recognized, there is no doubt that the surface of a flint exposed by thermal effects is much duller and less bright than those resulting from the other agents of breakage. I have supposed that this difference may be likened to the differing appearance to two apples, one of which has been pulled apart by the hands, giving rise to a roughened, "rocky" surface, while the other has been cut with a knife.

TO put this theory to some sort of test I had a number of the fractured surfaces of flints, broken both by thermal and by percussive action, photographed through the microscope. The accompanying illustrations (Figure 4), which are magnified 100 times, show that the surfaces produced by the two methods of fracture differ markedly in their appearance.

Thus, while there is no doubt that nature can and does flake flints in various ways, yet as our knowledge grows we are becoming able to distinguish between these productions and those which are the result of man's handiwork in the dim and distant past.

(This is the first of three articles by Mr. Moir, on flint flaking.)



ANOTHER COMPARISON

FIGURE 4: Photomicrographs of flint surfaces fractured by human blows (left), and (right) fracture by natural thermal agency

On the Road to Anywhere

*A Home-built Camp-car Which Has
Carried its Owner and Family
Many Thousands of Miles*

By RICHARD RICKARD CARRYL

OUR car was performing so wonderfully, was giving so much pleasure for so small an outlay, that the idea was born that we might be able to get even greater enjoyment from this able and dependable means of transportation by building a house-car body thereon.

Even as we measured our car, ideas about details were coming rapidly to us. Plans and sketches were made; definite dimensions were decided upon, and, with final plans made, the necessary material was ordered to be delivered to our New York City home.

The work had to be done in our back yard and basement and during evenings and holidays only.

Like "a bull being led to the slaughter block," our faithful Buick was driven to the back yard, and there, in two hours, the top and body were removed, the body being cut at the front door hinge down to the frame. The windshield was left intact but this was later erected in a new frame.

The three inch by four inch by 11 foot spruce sills were laid flat, parallel to the side frame members. Then the two inch by four inch floor joists were laid flat across the sills at one foot intervals. Upon this, a blind-nailed, tongue-and-groove floor was laid and then covered with a grey-pattern linoleum. The side frame was then erected, using three thicknesses of clear pine stock, three quarter inch by two

and five eighth inches, mortised at all doors, windows, and other openings. The frame was covered horizontally with tongue-and-groove wainscoting, securely nailed. Rafters were placed one foot apart and screwed to the plate besides being locked at the ridge on the under side with six-inch strap hinges. These rafters were then covered with wainscoting, blind-nailed, and this covered with heavy canvas and treated with a waterproofing liquid. The outer sides were covered with a light weight tin, of a pressed brick pattern.

FIFTEEN windows were provided with a total of 30 square feet of glass; this amount not including the windshield. Four of the windows were of the sedan sliding type, fitted with white-metal catches, while the others were mounted rigidly in swinging doors and windows.

The interior was lined with wall-board. All openings were protected with fine-mesh copper screen drawn tightly on steel braces hinged in place.

The lower two thirds of the back door tips outward and downward, forming a flight of back steps, as five steps were built on its inner side. The upper one third of the back door carries a plate glass window and is hinged at its upper edge to swing outward and upward as do two other windows of equal size on each side, thereby form-

ing a roof over the two window openings and back steps when they are open.

In each side wall was built an opening permitting the making up of two double beds, this being accomplished by a large panel, six feet long by 43 inches wide which is hinged at the top, and which contains three windows. These panels swing outward from the bottom and form a roof over the half of each double bed that tips out and is held horizontally by supports below. The ends of these enclosures are protected with two thicknesses of canvas held in place with fasteners.

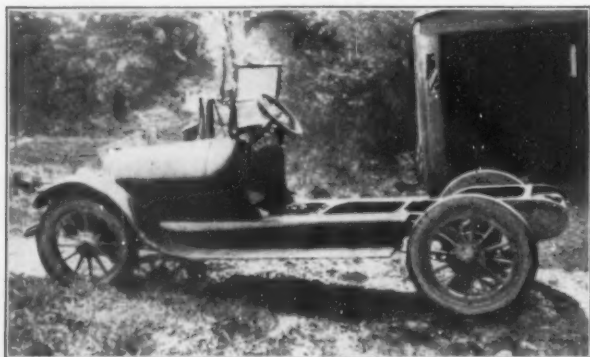
All windows are trimmed with old rose shantung curtains which, from without, blend well with the outer color and, from within, give a pleasing contrast to the grey walls.

Within the side walls and above the swinging panels referred to above, were built 12 small closets, which did not crowd the interior, yet added much handy space for numerous small articles. In the rear left-hand corner is an ice box which will hold 30 pounds of ice and satisfactorily keep it for four days. Mounted upon this ice box is a two-burner gasoline stove, fed from a five-gallon pressure tank located on the left running board. An air pump provided within the car maintains the correct pressure which is indicated by a conveniently located gage. "Sterno" is used to prime the gasoline stove.



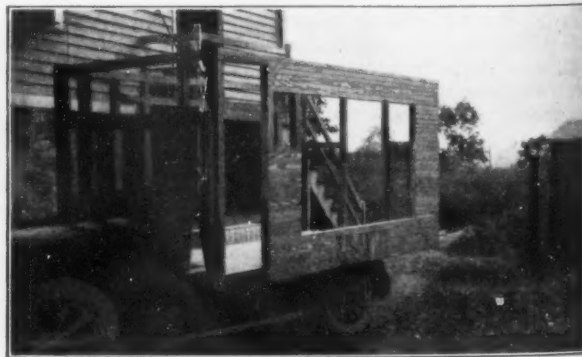
"THE WANDERER OF THE HIGHWAY"

The complete camp-car that was built by the author and is described in full in the article published below



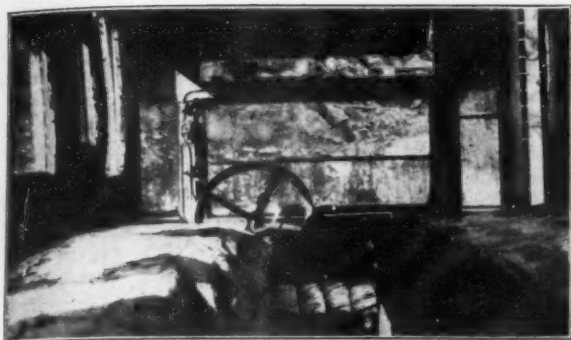
THE STRIPPED CHASSIS

The body and rear fenders have been removed. The next step is to lay the spruce sills and the floor joists, as described in the text above



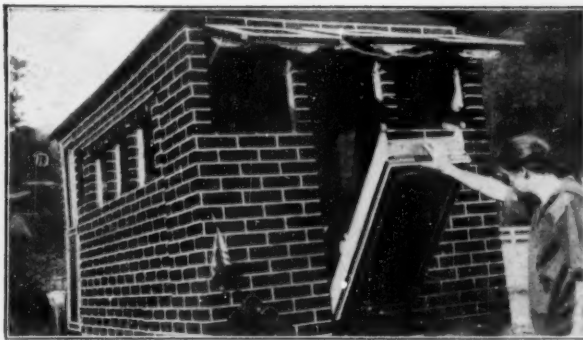
UNDER CONSTRUCTION

The floor has been laid, and the frame covered with tongue-and-groove wainscoting. Notice the opening left for placing the folding bed



READY TO TRAVEL

Looking forward to the driver's seat and the road beyond. The two double bunks are folded for traveling. The windows give ample light



THE BACK STEPS

The panel in the rear of the car lets down as shown when in camp. A flight of steps built on the panel give access to the car's interior

In the rear right-hand corner is a kitchen cabinet, with five large drawers. It has a folding shelf on its upper edge, as also has the ice box.

A clock and a circular thermometer are located at the center on the upper back wall, with an electric wall light on each side. The gasoline pressure-gage is located near one of these lights.

Two rear view mirrors are used, one being located on the inside and the other outside.

On the front wall are mottos and pictures. The mottos are: "Let Me Live in a House by the Side of the Road," and, "Out Where the West Begins."

Two double beds make up with woven springs and mattresses, and ample wool-filled quilts, blankets, sheets, pillows, et cetera are carried for comfort.

In front of the beds are two, large, very comfortable, bucket seats, upholstered in grey to match the grey painted interior and the grey bed slip covers.

A large waterproof wardrobe is mounted at the right of the hood on the running board. On the opposite side the spare tire and rim are carried.

The entire car and body was painted red. Since the outside walls are covered with metal, pressed in brick pattern, a white line was painted between the bricks to represent the mortar of brick construction. The roof is brown and therefore it harmonizes well with the red brick wall construction.

A tool box is mounted under the rear. Tools are also carried under the front seats, and a supply closet is made of the right running board, where there is also a folding, locking step operated from within.

The spot light is operated from within and further serves as a trouble light although rarely used as such.

THE interior is lighted with a 21-candlepower dome light, besides the two wall lights referred to above.

The table is mounted on one standard of three quarter inch pipe, located in the center of the car and connecting with fittings in the ceiling and the floor. This standard is removable.

Supply boxes are carried under the beds for such articles as shoes, books, guns, and fishing tackle. During the day the beds fold into single widths and are covered with slip covers to serve as couches, each one being over two feet wide. The beds are mounted on one half inch pipe posts, nine inches high.

The door panels are covered with red enameled canvas and trimmed with white enameled half-round moulding. Over the windshield a large window protected with copper screen can be opened at night or during warm weather when traveling.

So that everything of interest could be seen when passing through interesting country, the windows were arranged as follows: three in the back, five on each side, and one on each side of the windshield, making 15 in all, in addition to the windshield.

Below the body, the frame was made longer and two leaves were added to

each rear spring, making each one weigh 96 pounds. They were inverted and turned end to end, resting their centers over the axle.

The general dimensions of the body are as follows: length, 11 feet; width, six feet; height at eaves, five feet, making possible doors five feet by 18 inches. Inside center height over passage is six feet and width when beds are open is 10 feet.

It is truly, a comfortable, cozy home, and it has proved its worth many times over, over the many thousands of miles it has traveled, on all kinds of roads and in places where there were no roads at all.

By a neat sign on its front it is known as the "Wanderer of the Highways."

How old are the everlasting hills? A mighty interesting question, this, and one that will be answered in just as interesting a manner by a person who amply is qualified to do so. Watch for this article in the near future.



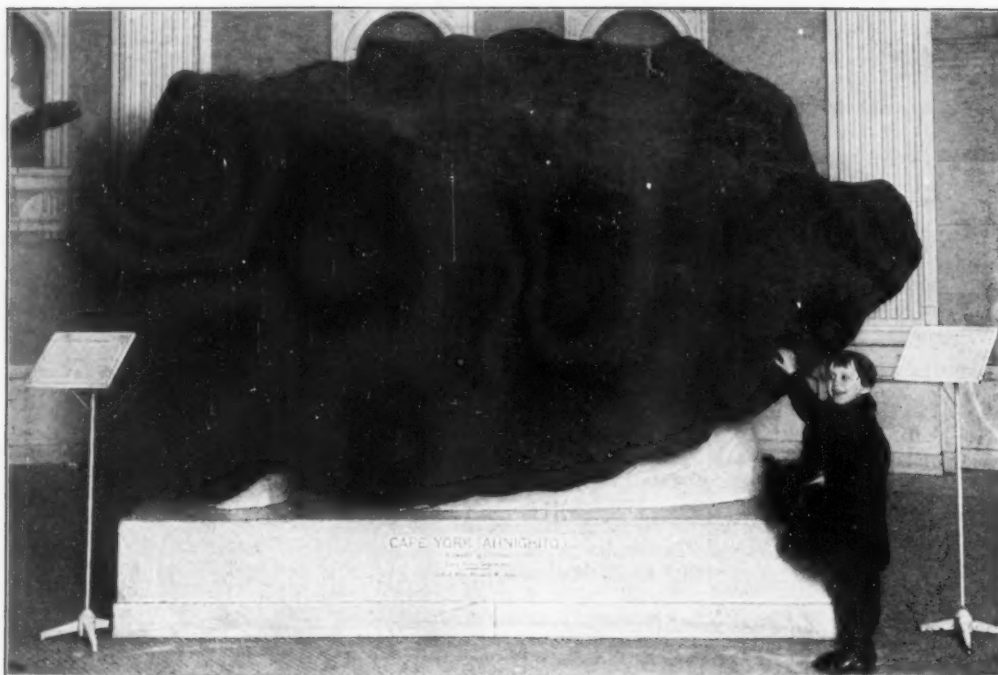
ICE BOX AND STOVE

A good ice box and a compact stove are invaluable assets to the confirmed motor camper



AN OPENED BUNK

The side of the car has been swung outward on its hinges, allowing the unfolding of the bunk



Courtesy of the American Museum of Natural History

ADMIRAL PEARY BROUGHT BACK THIS METEORITE FROM GREENLAND

It is a siderite, composed almost wholly of nickel-iron, and the stone and iron. The large majority are stone, while weighs 30 tons. There are two main classes of meteorites, many fall between these general classes in composition

The Significance of Meteorites

What Is the Origin of Meteorites? To Concoct a Theory Is Easy, But Proof Is Still Lacking

By FRANK WIGGLESWORTH CLARKE, Sc.D., LL.D.

Chief Chemist, United States Geological Survey, 1883 to 1925
Member, National Academy of Sciences; American Philosophical Society

EVERYONE who has paid any attention to the subject of meteorites knows that they fall into two fairly definite classes; namely, meteoric iron, and meteoric stone. But these classes are not sharply distinct; they shade into one another. The irons often contain inclusions of stony matter, and the stones often have inclusions of iron. The "pallasites," for example, are masses of meteoric iron thickly sprinkled with nodules of olivine, and few stony meteorites are free from particles or masses of iron.

The iron in all, or nearly all, meteorites differs from ordinary iron in that it contains nickel, often up to six or eight percent, and it is almost invariably crystalline in structure, which is shown by the remarkable figures that appear upon a polished surface of meteoric iron when it is etched by treatment with nitric acid. Meteorites, especially irons, commonly contain other inclusions which have much significance, and which are sometimes quite large. These will be considered

in a later part of the present discussion.

When a meteor is seen to fall, what has happened? A solid mass coming from the cold of outer space with something like planetary velocity enters the Earth's atmosphere. Its motion is retarded; much heat is generated; and the surface of the mass is raised to the temperature of fusion. It then expands and is blown off in dust, which forms the luminous train that is a conspicuous feature of the phenomenon. The main body of the mass may or may not be broken up into fragments, which under favorable conditions fall to earth and are picked up, later to find their way to museums.

THESE conditions, however, are not frequent; many meteorites doubtless fall into the ocean, in forests or in deserts, or far from human habitations, to be seen no more. The actual finds, relative to the falls, are doubtless very few. The smaller meteors or shooting stars are common enough, but they, if ever, reach the Earth only as very fine dust which

attracts no attention. The meteorites which are recognized as such, vary in size from a mass weighing only a pound up to one of many tons. Sometimes a fall may be more definitely described as a shower of many members, some of them of iron and others of stony matter. But single masses are more common.

The physical structure of a stony meteorite is very suggestive of its origin. Apart from its inclusions of nickel-iron, it is almost entirely made up of silicate minerals such as form our common igneous rocks, like olivine, anorthite, pyroxene, and so on. These minerals are all highly crystalline, and crystallize only from a state of fusion. Many of the same minerals have been prepared artificially, by melting their constituent oxides together. Quartz, however, and the feldspars, with the exception of anorthite, are almost entirely absent, for their minerals were probably in the outer layer of the meteor, and formed most of the trail of dust.

The thermal origin of the stony

meteorites is also indicated by a sort of black varnish, another product of fusion, which covers the stone and marks its difference from ordinary terrestrial pebbles or boulders. The crystalline character of meteoric iron is also evidence that it originated from a fused mass slowly cooling under great pressure. The presence of microscopic diamonds in the meteoric iron of Canyon Diablo, Arizona, tells the same story, for by just that method Moissan produced his artificial diamonds. A stony meteorite might well be described as a mass of igneous rock. Its inclusions of iron are sometimes paralleled in certain basalts.

THE inclusions that occur in meteoric iron have already been briefly mentioned. In addition to the diamond there are several others of greater significance. Large nodules of graphitic carbon are common, and so too are those of troilite, a sulfide of iron,

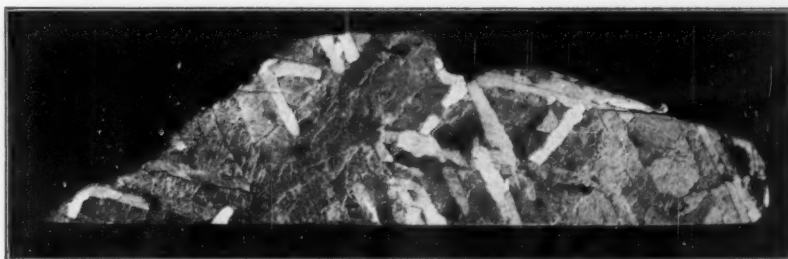


BRENHAM METEORITE

Section of a mixed stony and iron meteorite which fell in Brenham, Kansas

which is rarely found as a terrestrial mineral. Less abundant are a carbide of iron and one or more phosphides. An even more noteworthy inclusion is a chloride of iron which on contact with water is decomposed, or hydrolysed, yielding a sediment of basic chloride and much free hydrochloric acid. The acid, so to speak, devours the iron and converts it into rust. This inclusion is the bane of all curators of collections of meteorites, an enemy which it is difficult to control. It is found not only in meteorites, but also in the native iron of Ovik in Greenland, and that fact is of much significance.

The presence of such iron in the



SECTION OF PEARY'S "AHNIGHITO" METEORITE

When sectioned and etched with nitric acid, the iron meteorites reveal their peculiar crystalline structure. These are called the Widmanstätten figures. They result from former slow cooling

nucleus of the cooling Earth must have generated much hydrochloric acid, and so the primitive ocean was probably acid, to be neutralized later by inflowing fresh waters carrying carbonates in solution. This conclusion, if sound, sheds much light upon the evolution of early forms of life, a subject which I cannot discuss more fully here.

When a large meteor falls, its fall is generally announced by a violent explosion, with a noise like thunder. The meteorite is then broken up into fragments which may be scattered widely. When such fragments are carefully sliced and polished, details of structure appear which could not otherwise be detected. For example, a large meteorite fell a few years ago at Cumberland Falls, Kentucky, and its larger fragments were most instructive. The polished slices showed a complex structure of which the most noteworthy feature was a change from a distinctly crystalline character seen in most stony meteorites to a mass of broken, angular fragments, or in other words, a breccia. The original crystal had been crushed under very heavy pressure, and the fragments afterwards cemented together to form the new kind of rock. It is not easy to see how this could have happened except in the breaking up of a large body of subplanetary dimensions, possibly something like an asteroid.

THE cause of such a catastrophe is yet to be discovered. For the present, speculation must suffice, but other writers have also suggested an origin for meteorites much like my own interpretation of the phenomena. Between meteoric and terrestrial matter the analogies, as we have seen, are many, but there are also differences which cannot be ignored.

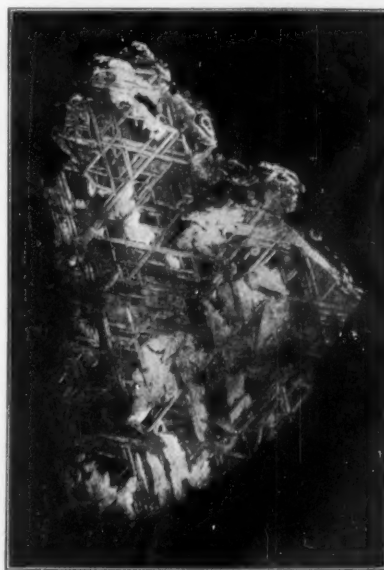
It is now quite generally believed that the Earth was originally a molten mass, which cooled to its present form. It consists of a huge nucleus of iron surrounded by an envelope of igneous rocks, the heaviest near the nucleus, with an outer shell of light or alkaline varieties. There are also very thin strata of sediments and the oceans and the atmosphere. If the Earth should ever follow the example of our supposed asteroid, these outer shells would be thrown off first, and the new meteorite

would exactly resemble those we already know. Would they fall to another planet, or into the Sun, or circulate in orbits of their own? To speculate upon that problem would be a waste of time.

In comparing the supposed asteroid with the Earth, the great difference in size must be taken into account. The larger mass contains a much greater number of minerals than the smaller, and it has more of the elements.

THE elements which are found in meteorites are, however, identical with those which are common in the Earth. This may seem to be self-evident, but it is not necessarily so. To settle this question, some very careful and thorough analyses have been made and the atomic weight of meteoric iron, nickel cobalt, and chlorine are found to be the same as those of terrestrial matter.

No new elements have as yet been discovered in any meteorite, nor is it at all probable that any ever will be. But it is not safe to prophesy as to future possibilities. The history of science contains many examples of prophetic failures.



WIDMANSTATTEN LINES

This etched section of the Knowles Meteorite shows well the crystalline structure



IN SAGI CANYON

Above: Mr. Bernheimer in camp. Directly below: A near view of the westerly edge of the Betatakin ruins built on the cliff 125 feet above the canyon floor. The ancient stone houses nestle on the cliff side as though built by swallows. Note the cedar beams supporting the floor and roof, still in good shape after the passage of centuries



TRACKS

These dinosaur footprints were found in 1924 in the Neska Nizadi branch of Navajo Canyon

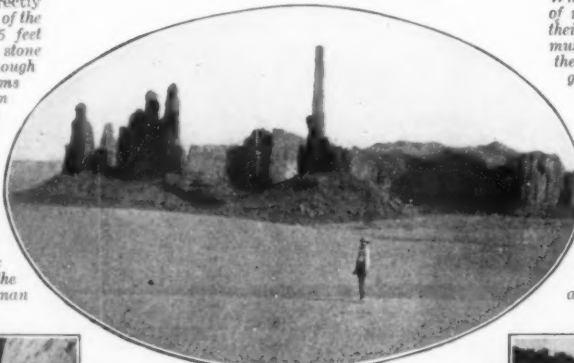


THE "BALDHEADS"

When crossing the steep, slippery expanse of rock, it is necessary to let the horses find their own way, and occasionally, the men must use their hands in climbing, so steep is the slope. "Daredevil" Al Smith in the foreground, was always the last to dismount when the party approached such dangerous passes as that illustrated above

SHIPROCK

Lower center: Because of its appearance when viewed from certain angles, this massive formation received its descriptive name. On one expedition, the Bernheimer party approached within a few miles of the rock by automobile. Rising 1800 feet above the desert, this rock has never been scaled by man



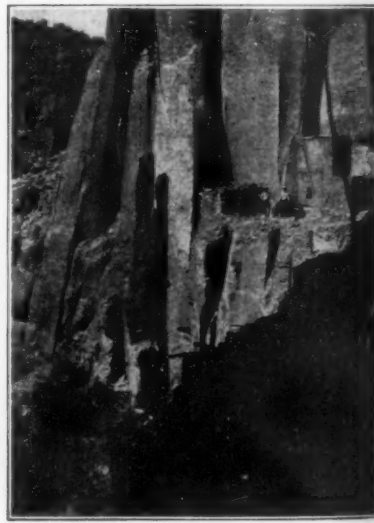
BETATAKIN RUINS

This is another view of the same section of the cliff dwellings illustrated in the lower left-hand photograph on this page. From this, one gets a more detailed idea of the location and extent of the ruins especially of the precipitous form of the cliffs which are at the same time foundation and back wall of the crude dwelling-places



SAND DUNES

Above: The rock formations in the background have been chiseled by blowing sand



A Business Man Turns Explorer

REFRESHINGLY different from the usual run of vacations is that which Charles L. Bernheimer takes each year. For 10 months he is a textile manufacturer, while for the other two months of the year, he is an amateur explorer, taking his play in the great areas of the southwestern part of the United States, and adding not a little to the general knowledge of the country which he visits.

Mr. Bernheimer describes his two-fold reason for taking these unusual trips in the following manner: "My first object is to instill a love of nature in its bleakest and sternest moods, where the conventionally accepted ex-

hibits of beauty are not found, and the second is to conduct a layman's scientific expedition where professional skill is not necessary, but where the results will be sufficiently accurate to swell the sum total of human knowledge. That the American Museum of Natural History allows its name to be used in connection with these vacations shows that the results may be valuable enough to warrant the continuation of such efforts."

Mr. Bernheimer's journeys have been made for over 10 years and on these pages are reproduced several photographs which show the wild, scenic beauty of the region traveled. Not only has the joy of seeing new places been a



QUICKSANDS

Above: The banks and bed of this stream are masses of deceptive sand. Travel here is advised only in the dry season, and then only with caution.

RAINBOW BRIDGE

Right: This beautiful, rainbow shaped span is 308 feet high and 274 feet between its abutments. Mr. Bernheimer has formed a theory that this huge, graceful arch is the result of ancient water erosion from both sides.

ANOTHER VIEW

Below: Rainbow bridge as it appears from the south, showing the huge mass of rock, at the left, that supports the tremendous arch at the eastern end.



ON KEETSEEL CLIFF

Here the cliff-dwellers lived in comparative comfort and security about one thousand years or more ago. In these ruins is to be found the "big beam," a log more than 24 inches in diameter and over 30 feet long, hewn with stone axes of ancient man.



NAVAJO CANYON

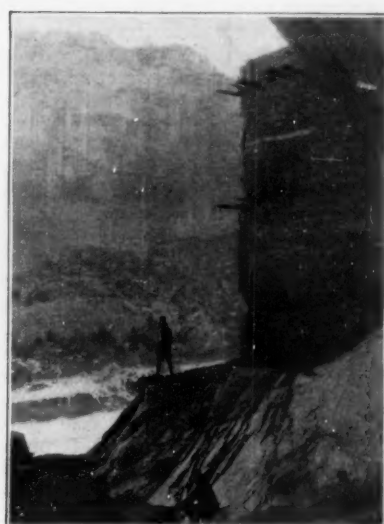
Above: Looking up the beautiful gorge, the walls of which are literally lined with the homes of the ancient cliff-dwellers of the United States.

AN OASIS

Lower center: A side canyon in the Canyon del Muerto. Note the luxuriant growth of the cottonwood trees, upon which animals will browse when the foliage is dry, but which they will leave strictly alone when it is green.

IN MUMMY CAVE

Close view of the center tower. The masonry is as neatly done as though it were the work of an expert in the present-day art of cabinet-making.



part of the trips, but dangers have been far from few. When traversing the regions of huge rock formations, it often happens that one mis-step will spell disaster. And in the river beds there are quicksands to be considered. See photograph at top of this page.

While it is possible to make part of the trips by automobile, still there are places where man has to depend on horses and pack animals, and often on his own feet and hands to carry him through safely. In ascending the

"Baldheads" pictured here, for example, it becomes necessary to dismount and proceed up the smooth slope on foot, and often on hands and knees. Without riders, the horses can take care of themselves.

But even the dangers enumerated, and many others, are not drawbacks that daunt the explorer. Rather they add zest to the occasion, and when the next season comes around, there he is, ready to go once more into the unknown regions to hunt knowledge and recreation.

Pulverized Coal Goes to Sea

Trial Trip of Shipping Board's Freighter, Converted to Use This Fuel, Is a Success

By F. D. McHUGH



Photograph courtesy Peabody Engineering Corporation

CARGO SHIP "MERCER"

The first sea-going vessel to be equipped with burners for pulverized coal and machinery for preparation of this fuel

EARLY this year, the attention of marine engineers and the entire shipping world was centered on the trial trip from New York to Holland and return, of the United States Shipping Board freighter, *Mercer*. The success of this trip, as announced by the supervising engineers, marked the birth of a new epoch, it is confidently believed, in steam generation for sea-going vessels. The *Mercer* is the first ship to be equipped with burners for pulverized coal and machinery for preparing this fuel.

Although the installation of this apparatus and the subsequent trips of the *Mercer* have been experimental, they were, in effect, the final proving tests following experiments carried on in the testing plant of the Philadelphia Navy Yard some time ago. The equipment on the *Mercer* is substantially the same as that used in these land tests, only minor changes having been made.

THE diagram at the bottom of this page illustrates the various pieces of apparatus used in this installation. It consists of, in the order of their functioning: a bunker arrangement for low-grade coal; conveyor for this bunker fuel; coal crusher; coal pulverizer; and distribution pipes through which the powdered fuel is blown to each set of furnace burners. Everything is so arranged as to reduce to a minimum the handling of coal by man-power which fact is expected to result in a material reduction of operating wages and subsistence costs.

Pulverized coal has been used for many years as a fuel for stationary plants on land, and has proved its superiority over lump coal in improved efficiency, saving of labor, and steady steaming conditions. But in a land plant, the boiler space can be made of

sufficient dimensions to permit burning in the necessary amount, while the furnace space in a Scotch marine boiler is exceedingly cramped. In the former, the space had to be large because of the limitations

of the known methods of pulverized coal combustion; but in the latter, on ships, every inch of space was naturally conserved. Thus the essential thing necessary for the adaptation of this fuel for ships lay in the design of a burner that would make possible generation of the desired steam.

For the development of a burner for this purpose, credit is due the Peabody Engineering Corporation of New York. Following development of atomizers for furnace oil-burners, and later, one for the burning of either natural gas or oil, this company turned its attention to the pulverized coal problem. Since pulverized coal in air

acts very much like gas, the installation of the Peabody gas and oil burners in a plant in New York City, to burn either oil or pulverized coal, was an instant success, and the solution of the Scotch boiler problem was in sight. As a result of a demonstration at this plant, the corporation was invited to send a set of its burners to the testing plant of the Philadelphia Navy Yard for trial on land in Scotch marine boilers.

PREVIOUS tests for adaptation of this fuel to the Scotch boiler had been made but had been failures due, primarily, to imperfect burners and a long flame with slow combustion. The test of the Peabody burners was at once an unqualified success according to marine engineers and shipowners who witnessed the test. Immediately following this test came the Shipping Board's conversion of the *Mercer*.

To this burner which is installed in the furnace throat, the pulverized coal comes from the pulverizers through pipes together with its carrier air,

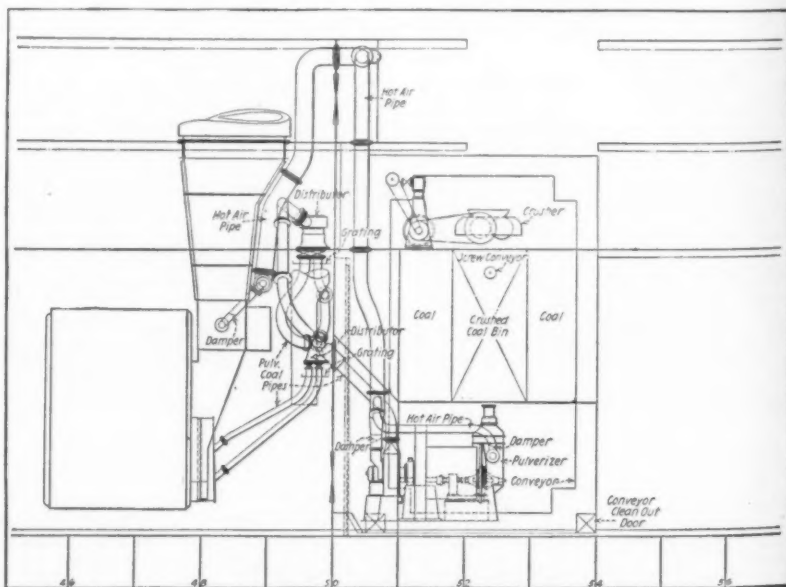


DIAGRAM OF THE EQUIPMENT USED

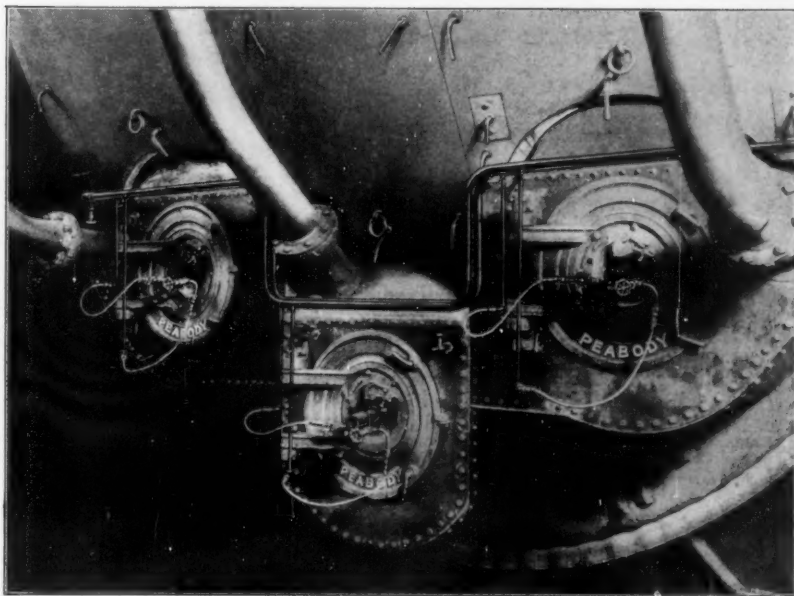
From the bunkers the lump coal goes to the crusher to be broken small; thence passes to the pulverizers; and finally is blown by air in pipes through distributors to the furnace burners

enters the coal chamber, and from there passes through an annular opening into the furnace throat. At the throat it encounters the secondary, or booster, air which is entering in a state of great turbulence due to the rotary motion imparted to it in passing through the register. The resulting quick and intimate mixing of air and fuel insures rapid combustion, the secret of the solution of the problem.

OF the machinery necessary for preparing the fuel for these burners, little need be said as it is practically standard as used on land. Briefly, however, the lump coal passes from the bunkers into the crusher which breaks it into small pieces one and one half inches in size or smaller; this, in turn, goes to the ready-feed bunkers which discharge directly into the pulverizers as needed; and the pulverized fuel is finally blown through pipes to the distributors for distribution to the different burners. The main coal bunker is constructed with tapered sides to allow steady "flow" of the lump coal and thus minimize trimming operations.

The pulverizers used, of which there were two for supplying the three Scotch boilers on the *Mercer*, are of the air-swept, ball mill type. Each consists of two cylinders filled with about 5000 pounds of herculite steel balls, so arranged that these balls, rolling together when the mill is rotated, will grind the crushed coal to an impalpable powder. This powder is then carried into the feed pipes by air from the primary fan, and thence to the distributors which divide the fuel charge into three equal streams. In the test at the Navy Yard, the distributors were motor-driven, but on the *Mercer* a small steam turbine does the work.

According to Mr. C. J. Jefferson of the United States Shipping Board, to whom great credit is due for the ex-



APPEARANCE OF THE FURNACE AND BURNERS

Not the least important feature of the pulverized coal system is its cleanliness due to the absence of the objectionable coal pile. No stoking, and but little bunker trimming, is necessary.

perimental conversion of the *Mercer*, but few defects were displayed in the operation of the ship from New York to Holland, and these were only mechanical difficulties such as are to be expected in all new installations. He states further that ashes were carried down to the after deck only because the vessel was built under wartime plans and has a very low, wartime stack.

This fault can be remedied by raising the stack so that, in a head wind, all ashes will be carried away.

The *Mercer* is a 9500 ton ship fitted with a 2500 horsepower General Electric turbine, three Scotch boilers, and the usual auxiliary equipment. Formerly an oil burner, she had been laid up for three years, and was selected for the initial installation for burning pulverized coal both because she is a desirable and typical cargo vessel, and because she has 22 sister ships in actual service, some of which are oil burners and the others hand-fired coal burners, thus making it possible to determine the real merits of pulverized coal by direct comparison.

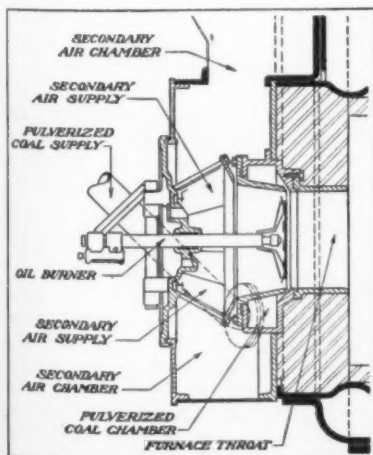
DESPITE severe mid-winter weather, the trial trip across the Atlantic was made by the *Mercer* in 14 days and nine hours, at an average speed of 9.83 knots, with a fuel consumption of 1.3 pounds per ship horsepower. These figures are remarkable in that they show excellent functioning of all apparatus while the ship was rolling at an angle of 30 degrees and pitching heavily; and because the fuel consumption of her sister ships is considerably higher, according to records.

Mr. Jefferson is authority for the

statement that the Germans, the Dutch, and the British are following up the lead of the United States Shipping Board in equipping ships with similar apparatus, while the Board itself has already decided to convert six more ships of its fleet as soon as possible.

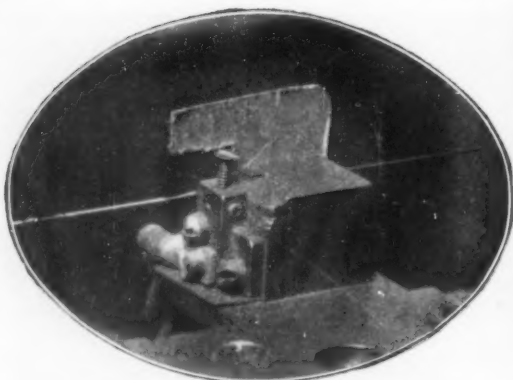
ONE English authority has made the statement that he sincerely believes this new ship fuel will, in time, entirely supplant oil in British vessels. British journals see in its successful application a revivifying agent for the British coal industry which now suffers from a surplus of low-grade coal which must be taken from the mines but for which there is little or no sale. Naturally this would hold true for other coal producing countries; but it would also aid the entire coal industry by releasing high-grade coal for other purposes—and at lower prices, too, since the wider use of low-grade coal would reduce mining overhead.

The importance of the developments of equipment for this fuel as applied to ships cannot be too greatly stressed. Marine engineers will continue their researches, will give careful consideration to the many ramifications of the problem, and we may expect in the very near future, many refinements of the original installation. It may not be long, for example, until ships equipped for burning pulverized coal will be able to load pre-crushed coal, or even pre-pulverized coal—if the dangers of spontaneous combustion can be minimized—directly into the bunkers through pipe lines, thus doing away with the old slow methods of coaling and eliminating some of the auxiliaries between the bunker and the burner.



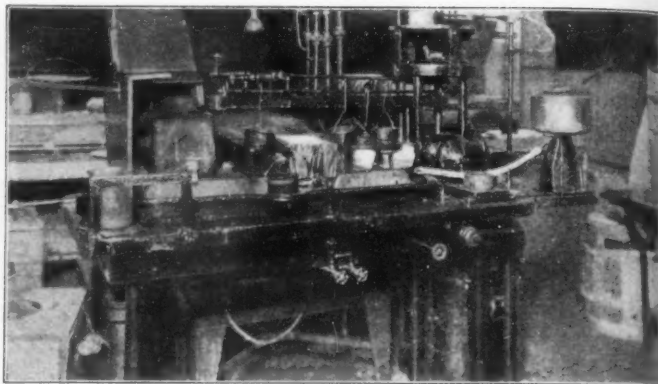
SECTION THROUGH BURNER

Pulverized coal, entering furnace throat with primary air, is agitated by secondary air



WINDING LAMP FILAMENTS

Heavy tungsten wire is wound in a spiral on a steel wire mandrel. The winding machine is designed to wind a certain number of turns per inch of filament length, without danger of short-circuiting any one of the adjacent turns.



DISSOLVING THE MANDREL

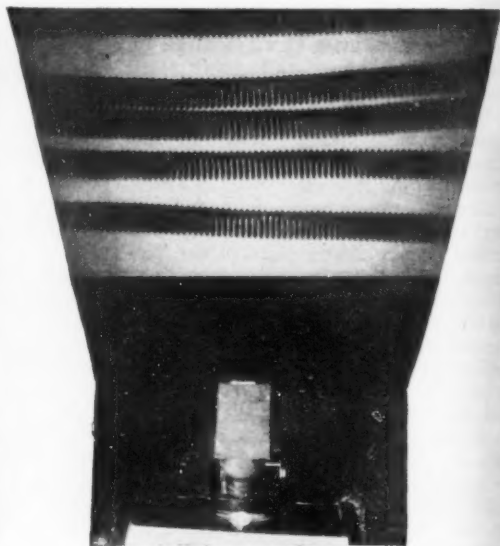
After the filament coils are wound on a steel wire as shown at the left, the mandrel is dissolved in an acid bath. In the photograph above, the left-hand dish under the chimney contains the wire-dissolving acid. The other dishes hold the washing baths in which the coils are oscillated.



All photographs courtesy Westinghouse Lamp Company

WATCHING THE COILS

Since the filament coils of the 15, 25, 40 and 50-watt lamps are made of wire much finer than a human hair, it is necessary that the operations of manufacture be carefully checked throughout all processes. The eye, unaided, cannot be relied upon, so a microscope is used.



MICRO-PROJECTOSCOPE

An additional inspection to that illustrated at the left is made with this apparatus, by means of which a greatly enlarged image of the coils is thrown on a screen, whereupon imperfections can be detected immediately by the eye.

Marvels of Lamp and Tube Manufacture

IN the manufacture of a modern lamp or radio receiving tube, the modern chemist and metallurgist continually strives for new perfections and searches for new materials. Nor does the art end there because, in the assembly of these materials, there is used a greater accuracy than ever was possible by the painstaking makers of the finest watches or the most intricate jewelry.

After metallic tungsten has been formed in rods, these are elongated and heated, being literally beaten into ductile bars. After the wire has been worked down to the number 14 size, it is drawn through dies until it reaches the final diameter in accordance with the wattage of the lamp to be made from it. As simple as this process sounds, it is, nevertheless, a really fine art. The drawing dies are made of the hardest diamond and the resultant wires for small lamps are much finer than human hair.

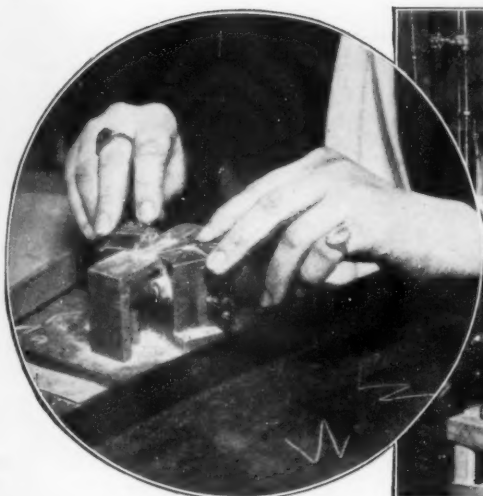
Then comes the process of winding the wire into helical coils. One method is to pass a rotating steel mandrel wire

by the winding machine, coiling thereon the tungsten wire as in the manufacture of a coiled spring. In other cases, the spool of tungsten wire is revolved around the mandrel, extreme care being taken to insure uniform spacing of turns.

After the coils have been wound, the mandrel is dissolved away in strong acid which does not affect the tungsten, thus leaving the spring-like coil of filament wire. During the coiling process, the accuracy is checked by high-powered microscopes. An almost inconceivable uniformity is necessary lest these filaments, when burned, operate too cold or too hot or else become distorted so that adjacent turns touch.

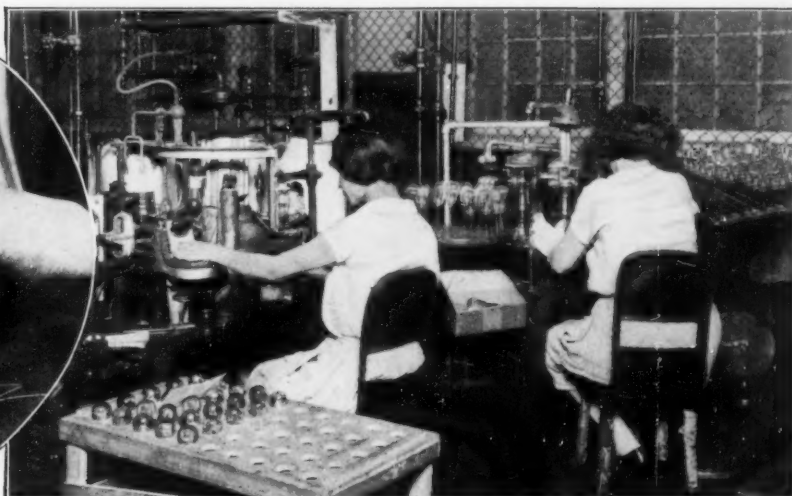
Even the microscopes are not trusted completely, for a final inspection of coils is made by magnifying them 100 times and projecting their images on a screen.

The next problem is to build the bulb and supports for these filaments. First, the glass tubing is cut into short



RADIO TUBE FILAMENTS

The operator in this photograph is forming filaments for UX-112A tubes. The fine wire is shaped in the jig to a form like that of a letter M. Some finished filaments are shown in the pan to the right in the picture



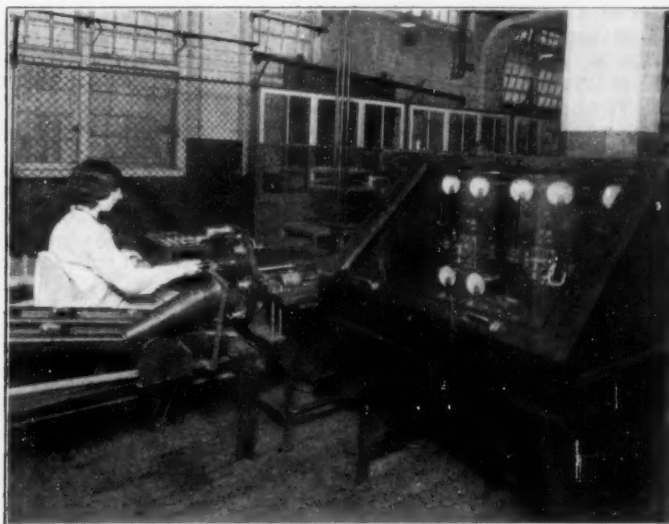
SEALING AND EXHAUST MACHINE

The elements (grid, plate and filament,) of the radio vacuum tube are assembled on their supports and then sealed to a glass bulb. The tube thus formed is transferred to the exhaust table where the air and gases are removed by means of powerful exhaust pumps and chemical flashing "getters" that were placed in the tube before sealing



SEASONING RADIO TUBES

When completely assembled, the tubes are seasoned to insure proper electron emission. The pilot lamps on the board above indicate to the operator when a certain tube fails to season in the proper manner. It is then removed



HIGH-SPEED TUBE TESTING

Tubes are tested here at the rate of 6000 per hour. If a tube needs more seasoning, it is ejected onto a moving belt which returns it to the seasoning machine. Permanently defective tubes are automatically rejected. The perfect ones are placed on a moving belt and carried immediately to the wrapping and packing tables

lengths with one end flared out, while on the other end is mounted a glass rod and the wire hooks to support the filament. Through the flared tube are inserted lead-in wires that are then sealed into the glass in order to form an airtight joint. These mounts are next inserted into the previously inspected and cleaned glass bulbs and sealed in by the action of flames playing on the rotating assembly.

When the bulbs are to be exhausted, there comes into play a series of peculiar processes and inspections. All the air is drawn out through a small tube at the base of the lamp and this tube sealed off. Bulbs must be heated carefully to draw out all water vapor; a special chemical must be inserted to clean up any residual gases; the exhausted bulbs must be subjected to a high tension electrical field to be sure no impurities are remaining; and all manner of mechanical checks are thrown around the manufacturing processes.

In certain radio tubes, the tungsten filaments must be

formed before mounting in the bulbs. This is a delicate operation because the coils must not be flattened and they must not twist or warp when heated. After tubes are fitted with their peculiar bases and the basing cement is baked on thoroughly, the electrical contacts are dipped into molten solder and the tube is ready for a long series of inspections.

One of the most interesting scientific developments is the method of insuring tube quality. For example, all radio tubes are seasoned by operation, thereby setting the electron emission at a predetermined figure.

Nothing is left to chance or to the whims of the individual operators. For example, as a final and dependable check, all tubes are run through a special device which automatically discards any tubes deficient in filament current, electronic emission and quality of vacuum. This machine is so sensitive that variations of two hundredths of a milliampere are detected and yet the testing proceeds at the surprisingly rapid rate of 6000 per hour.

Rattlesnake Farming



Courtesy of New York Zoological Society

Caring for Reptiles Assures a Constant Supply of Valuable Venom for Making Serum

By UTHAI VINCENT WILCOX

TWO young men of the West have established their own dairy farm, and they have no competition. This farm, perhaps the most weird in the world and yet the most lucrative in proportion to its acres, is all of 20 feet square and ten feet above the ground on the platform of a water tower. The "cows" are rattlesnakes!

The serpents are milked regularly and the venom which is extracted is sold to special laboratories where it is used to make a serum that may some day save the life of some poor man or woman who has aroused the ire of a rattler while out tramping.

These pioneers in this new reptile agricultural - chemical industry, are Leonarde Keeler and E. L. Woolsey, who first dated their interest in snakes to the time when, as Boy Scouts, they roamed the sun-baked hills bordering San Francisco Bay. When they needed extra money to put them through the University they found it in this first boyhood interest.

THE snake farm is in an old water tower near Menlo, California. Here great crawlers have the choice of a large cage where they may bask in the sun on warm days or an artificially heated den where the heat is thermostatically and electrically controlled. During the summer the reptiles roam about in the large cage in the quest of food or lie asleep in the shade of the rocks. During the winter they take to their warmer den, following their natural inclination to hibernate.

The basic source of supply is occasionally a problem. Mr. Woolsey said that they made expeditions to various parts of the western country in quest of their scaly milkers. "Last year I made a survey for the Spring Valley Water Company on their property at Crystal Springs Lakes,

California, and found it infested with rattlesnakes," Woolsey explained.

"Last summer we went to Arizona where we collected many fine specimens with the aid of the Navajo Indians whom we hired to track the reptiles for us. Incidentally we viewed the Hopi Indian Snake Dance and came very near losing our lives because we followed one of the Indian runners, hoping to get one of the snakes used in the dance. You see we wanted to find out if its fangs or venom sacs had been tampered with. We didn't find out," he admitted.

"WE try to get as many species of rattlesnakes as possible," Woolsey said. "In the winter, when our supply of snakes runs low, we get some

"We use a long tube with a funnel attached to one end. Hamburger steak is mixed with water and forced into the funnel until the tube is full. The tube is then greased and the small end inserted into the snake's mouth and forced down its throat until it reaches the stomach. A plunger is then inserted into the tube and the hamburger is expelled." Thus the snake gets its meal without the trouble of having to swallow it.

"But during the summer months, we have no trouble," he explained. "The reptiles will eat voluntarily and demand plenty of rabbits, mice, rats or guinea pigs. These all have to be lively for they will not touch any dead or diseased food."

The bigger the snake, the better milker he is, but the danger is all there whether big or little and each has to be attended to regularly. "The larger the snake is, the better it is for our use," Woolsey said. "The large snakes have the big poison sacs and consequently more venom."



ONE OF THE SNAKE "COWS"

The proprietors of the unique rattlesnake farm, holding one of the reptiles which are "milked" regularly of their venom

from Texas, the home of the second largest rattler in the United States, the Texas diamond-back."

The feeding of the snakes is one of the chief problems with which these young scientists have to contend. "You see, they refuse to eat in winter and as fasting rattlers are of little use as 'milkers,' we have to resort to force-feeding," continued Woolsey.

sure you, for they are pretty powerful and will thrash about wildly unless one of us securely holds him.

"Next we open his mouth by using a spatula. A small glass dish is placed so that the snake's fangs protrude over the edge. We then press with the thumb and index finger on the poison sacs. These sacs are located slightly below and about half an inch back of

"THE snake that is to be milked is taken from the cage with a hooked stick and put on the floor, where his head is held down by another stick. Then the noose is slipped over his head and drawn tight on his neck so that he cannot move his head about or easily get loose.

"One of us holds the snake while the other extracts the venom. It is most necessary to hold the snake, I as-

the eyes." (See accompanying illustrations.)

"The dangerous part lies in the care that must be taken that the fangs do not slip off the edge of the dish, for if this happens, the great reptile can then bring his fangs down and inject his deadly virus into our fingers! Naturally that wouldn't be so good.

"As pressure is brought on the sacs, an amber colored fluid flows from the fangs into the dish. This is the venom, which causes quick death when in-

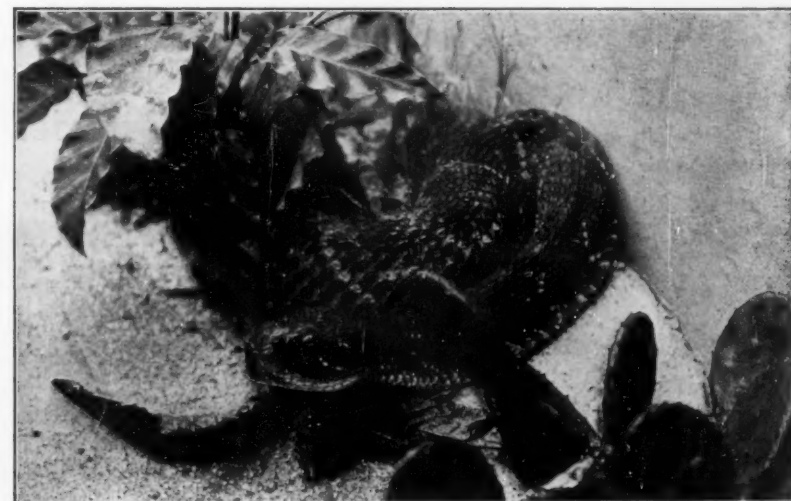


EXPOSING THE FANG

The protective sheath is drawn back so that the hollow fang may be inspected

jected into the blood stream of any mammal. We get about 20 drops of venom every other week from the largest rattlers. After this venom is forced out of the sacs, the container is removed and the snake's mouth is washed out with a dilute solution of permanganate of potash.

"We find that it is necessary to sterilize the snake's mouth so as to prevent it from getting sore jaws. A snake with a sore mouth would be useless, for the venom would not be pure.



A TEXAS DIAMOND RATTLESNAKE AT PEACE WITH THE WORLD

"Next we draw the venom into a bottle and cork it tightly to prevent its contamination."

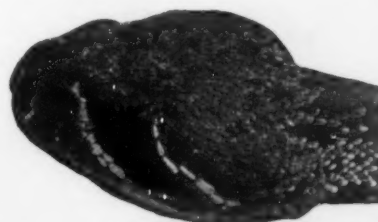
Mr. Woolsey explained that after milking all the snakes, the poison is placed in open dishes and dried, reducing it to a powder. This takes considerable care, for no foreign substance must come in contact with it and all bottles and carriers must be chemically clean. The dried venom is then sent to the laboratory where it is used to make a horse serum.

THESE youthful scientists are doing research work with their reptiles, working in conjunction with the serum laboratories. They are under contract to supply a regular amount each week in the year.

There are a few snake farms in the country, run by men who supply snakes to zoos and circuses. So far as is known by Keller and Woolsey, they

are the only ones in America who run a rattlesnake dairy. They thus have a monopoly on the business at present. There is a considerable profit, although a high mortality on the snakes. Both of them have been scratched by the fangs but neither has as yet been struck. Their easy handling of the great square-jawed fellows speaks both courage and expertness in their peculiar work.

As indicated by the name of the reptile, the distinctive feature of the rattlesnake is the curious tip of its tail. This rattle is probably used to fix the attention of small animals when vibrated, and also as a warning; most snakes preferring to be left alone rather than to fight.

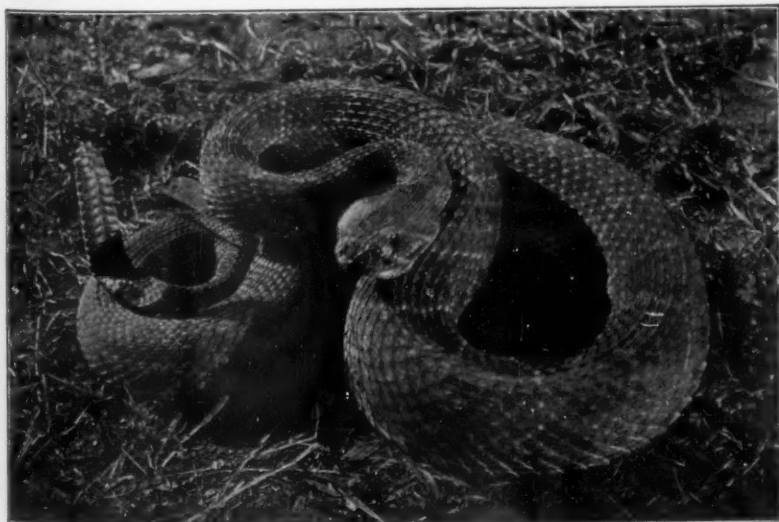


FROM FLORIDA

The marked head of a diamond-back rattlesnake whose native home is in Florida

The rattle consists of a series of hard, dry, horny cup-shaped joints, each of which is loosely fastened to the preceding one. Each time a rattlesnake molts, or sheds its skin, a new horny covering of the tip of the tail is formed below the old one, but the latter is not cast off. It forms then the next to the last rattle of the series. Often the end rattle is worn off or broken on rocks.

Many people are of the opinion that the number of rattles on a snake's tail indicates that reptile's age in years. Since snakes shed their skins more than once every year, this is obviously erroneous, although the number of rattles gives the snake's comparative age.



ANOTHER TEXAS DIAMOND-BACK

This is a six and one half foot specimen of this particular family of the snake tribe. Its fangs will inject venom a full half inch into its victim. See illustration at left above



DRIVING PRACTICE

Made in models for indoor and outdoor use, this device permits driving practice in a limited space. You can take a full swing and connect with the ball just as though you were on the tee, and the ball travels in a circle. As it does so, the pivot rises and registers the distance that the drive was good for.—*Playgolf, Inc., 640 Union Trust Bldg., Cleveland, Ohio*



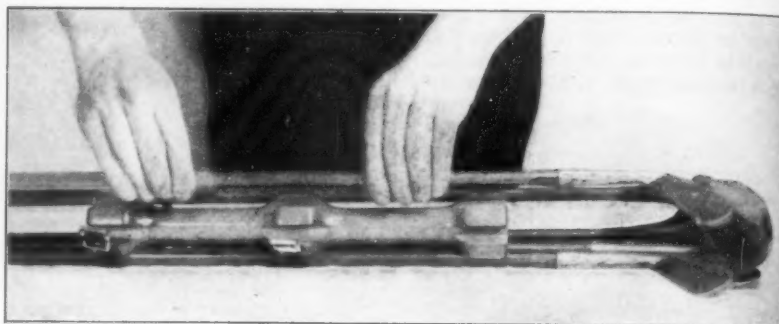
SWING IMPROVER

To teach the novice not to overswing, and to make him start the downswing properly, the strap for the left hand, illustrated above, is said to be invaluable.—*Blake Manufacturing Co., 2008 E. 46th St., Cleveland, Ohio*



STROKE COUNTER

This sturdy and reliable stroke counter may be strapped to the wrist, belt, or club bag.—*Low-Lee Sales Co., 53 W. Jackson Blvd., Chicago, Illinois*



GOLF CLUB PRESS

Storing golf clubs is somewhat of a problem because of the tendency of the shafts to warp. With this press, warping is impossible. The clubs are held in the series of notches by straps.—*A. G. Spaulding, 211 S. State Street, Chicago, Illinois*



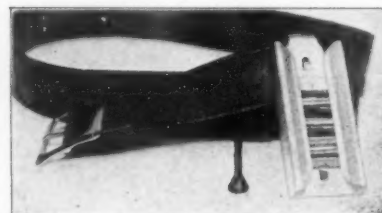
BALL MARKER

This rubber stamp marker will not cut or mar the surface of the ball, yet the initials impressed with a special ink are permanent.—*A. G. Spaulding, 211 S. State Street, Chicago, Illinois*



RUBBER-TOP TEES

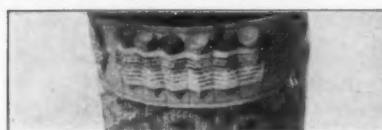
Tees with a wooden shank and moulded rubber head with four projections as shown are said to aid in making a straight drive.—*Veta Tee Mfg. Co., 556 W. 185th St., N. Y. C.*



TEE HOLDERS

Above: This automatic tee holder is designed to be attached to the belt. When one tee is slipped out, the next falls into place, ready for use at the next tee.—*R. H. Buhrke Co., 4538 Fullerton Ave., Chicago, Illinois*

Below: This combination tee holder and garter keeps the tees in their place where they are always ready for use, yet never in the way.—*Nee-Tee Garter Co., 11 W. 42nd St., N. Y. C.*

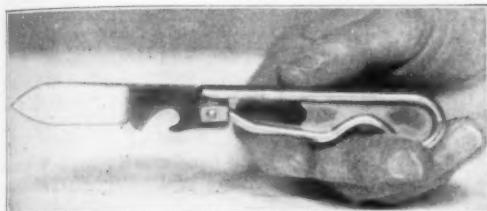


CLUB SEPARATOR

To keep the clubs apart, and prevent them from damaging each other during transportation, this separator may be attached to any bag.—*A. G. Spaulding, 211 S. State St. Chicago, Illinois*

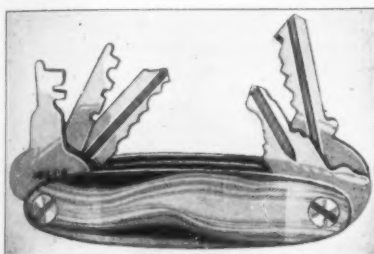
Inventions New and Interesting

Novel and Useful Devices Adapted to Many Human Needs



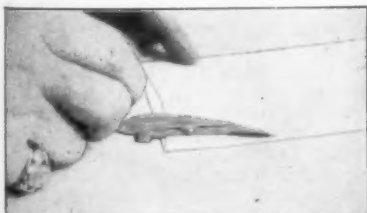
◀ CAMPER'S KNIFE

A handy knife to do all the odd jobs of the camper. It is wire-handled, has a heavy blade which is protected when in its handle case, and can be used to open cans or bottles.—*Wiebush and Hilger, Limited, 108 Lafayette St., New York City*



KEY-KNIFE

In this new key carrier, keys take the place of blades. Keys are inserted by opening the screws at ends. It comes in fiberloid in a variety of colors and finishes, and in various metals. Fraternity emblem or firm name can be stamped on the handle.—*Dodson Manufacturing Company, 2345 Fullerton Avenue, Chicago*

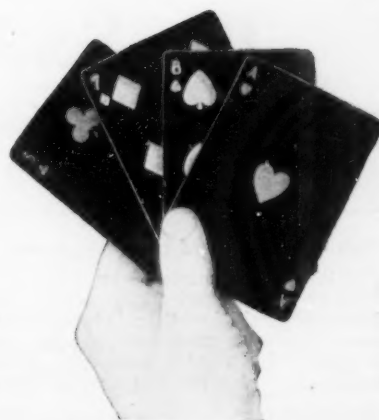


▲ CUSHION GARTER

This air-filled, cushion garter stays tight, does not interfere with circulation, and holds stockings firmly and seams straight. It is also useful for golf hose or sleeves.—*Toy-craft Rubber Company, Ashland, Ohio*

◀ RAZOR BLADE LETTER OPENER

This simple device, made entirely of metal, utilizes old razor blades. The tip acts as a guide to push under the flap.—*Nitmoi Manufacturing Company, Incorporated, New York*



EYE-COMFORT CARDS

You won't revoke with these new cards from England which have pips of different colors on a black background.—*Menzies and Company, Ltd., 439 King St. West, Toronto, Canada*



COMBINATION LOCK

The cylinders of this new combination lock are visible; no dial is used; lock is stronger and more secure than many.—*Sesamee Company, 476 Capitol Avenue, Hartford, Connecticut*



◀ ▲ NEW EQUIPMENT FOR THE FISHERMAN

Above is shown a new automatic reel that is strong, compact, and light. It weighs six ounces, will control 30 yards of double-tapered line; and has a new spring-tension throw-off and an efficient brake system.—*The Martin Automatic Fishing Reel Company, Inc., Mohawk, New York*. To the left is shown the rainbow spinner bait. Consists of a red and white rubber ball protecting three barbless hooks, above which is a spinner.—*Progressive Tool and Manufacturing Company, 559 Quincy St., Chicago*



NICKLE-IN-THE-SLOT

We thought we'd heard of all the "do-your-owns," but here is a new one. A coin in the slot turns on the current, and the customer curls her own hair.—*Electric Vending Corporation, 400 Hudson St., New York*

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Making Fiber Board from Wood Chips

CHIPS of wood exploded by steam are now being converted into wood fiber in the astonishingly short time of 20 seconds, as against several hours of cooking necessary in most of the pulp-wood processes. The explosions are the result of a series of ex-



Fiber for making board, and the chips from which it is made by the new process of exploding

periments made by W. H. Mason, a Louisiana lumberman, in his efforts to find a way to utilize the vast amount of waste resulting from sawmill operations. Until last year this waste was burned as fuel or for the purpose of getting rid of it. Developments of the last few months have opened a wide market for the material after its subjection to the explosion process.

The Mason "gun" is the agent for converting the waste lumber into fiber. The gun is a mechanical device into which chips are fed to be blown into shreds at a velocity of 4000 feet a second—equivalent to approximately 45 miles a minute. Each discharge of the gun handles about 200 pounds of green chips, produced from slabs and other rejected bits of lumber. Ten to 15 seconds of steam treatment softens the

wood, and the steam is then turned on with a pressure of 1000 pounds for a period of four or five seconds more. This intense pressure is followed by the opening of a discharge valve, causing the chips to be forced out at tremendous velocity, exploding into fiber as a result.

The fiber is used for making artificial board of great denseness, stiffness and hardness, with tensile strength of 4000 to 5000 pounds to the square inch. The new material has found ready market for use in automobile doors, desk tops, card tables, radio cabinets and paneling. It comes from the hydraulic press with one side smooth and polished, and capable of taking any finish that can be applied to ordinary wood. The entire process from chips to new lumber occupies but 45 minutes.

In another form, the exploded fiber is employed in making insulation boards.

The burning of waste material in special waste burners has constituted one of the biggest losses in the lumber industry. The new process introduces a new form of utilization and conservation.

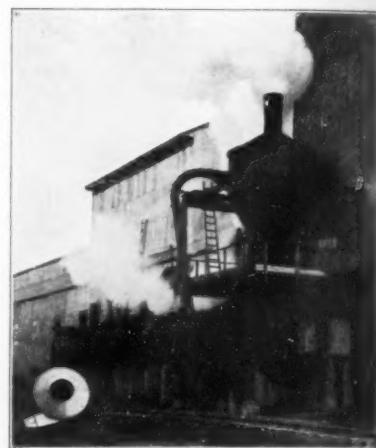
An Electric Bug House

THE San Joaquin County Insectary, Lodi, California, is the first insectary to use electric heat. The practice hitherto has been to use gas or other fuels, with manual temperature control.

This insectary is engaged in research work to determine the possibilities of using the beetle-bug, or so-called lady-bug, to rid vineyards of the mealy bug, a pest which is causing much loss. This mealy bug is a small insect which multiplies very rapidly and which thrives on the juices of the young and tender grapevine shoots. The female grows about four or five times larger than the male which it outlives. The bugs are very destructive to the grapevines, as the fluid substance deposited by them on the tender shoots causes mildew and a discoloration of the grapes, besides furnishing

food for very destructive fungus growth.

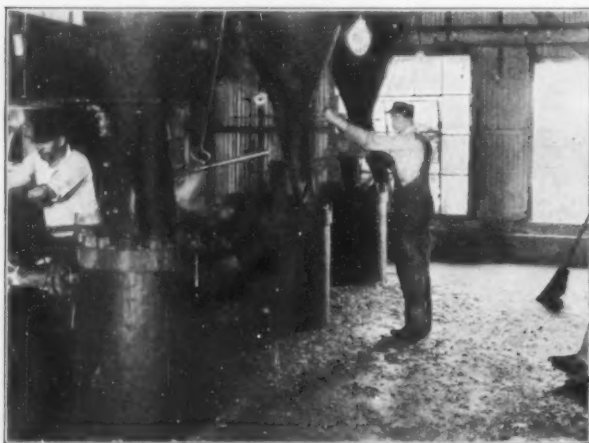
Beetle-bugs, however, live and thrive solely on mealy bugs. Thus, in the process of raising them, it is first necessary to raise mealy bugs to feed and fatten them. For this purpose potatoes are planted in small trays filled with a few inches of soil. Each room contains sufficient trays of potatoes to plant the equivalent of an acre. The rooms are kept dark and held at a constant temperature of 65 degrees Fahrenheit.



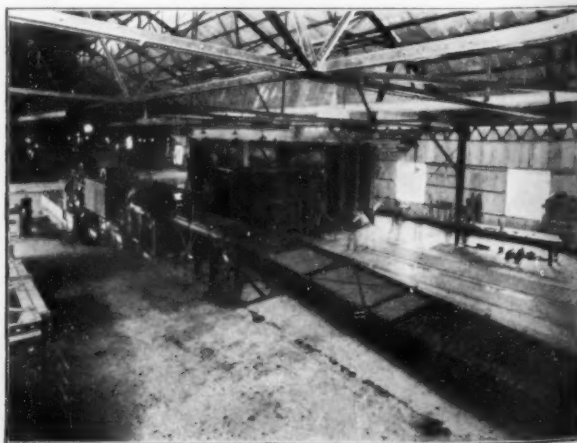
The "cyclone" into which the exploded chips are projected

height, until the potatoes have sprouted and developed long shoots.

After the sprouts have developed, a few mealy bugs are planted on them. The temperature from then on is maintained constant at 80 degrees Fahrenheit, causing the mealy bugs to multiply very rapidly, each batch producing about 600 eggs which hatch into bugs in about a month. After the mealy bugs have developed, beetle-bugs are placed on the



The "gun" room, showing three guns in which waste lumber is exploded after being reduced to small chips



Fiber resulting from the explosion process passes through a press and comes out as a strong board

sprouts to feed on them and luxuriate.

At present three different species of beetle-bugs are being propagated; one is imported from Australia and the other two are produced in California. The beetle-bugs eat nothing but the mealy bugs. They lay and hatch about 250 eggs at one time. The first hatch takes place in about 12 days, the insect being in the form of an immature worm or larva. The larva then develops into the adult stage. Before the stage of pupation or transformation the beetle-bugs crawl from the sprouts to sacks placed immediately behind the trays.

At this stage of the development light is admitted and the insects develop wings, when, seeking the light, they collect on the windows. They are then gathered from the windows and placed on the infected grapevines, about twelve to each vine.

The San Joaquin County Insectary has four rooms, each approximately twelve feet long, six feet wide and eight feet high. In each room is installed a 2000-kilowatt heater. Temperature is regulated by a thermostat and a contactor, both of General Electric manufacture.

Film Travels at Three Miles a Minute in New Camera

FEEDING "movie" film through a camera at the rate of three miles a minute to slow down rapidly moving machinery to about one two-hundredth of its normal speed, is the feat accomplished by C. Francis Jenkins, of Washington. At the meeting of the Society of Automotive Engineers in Detroit recently Mr. Jenkins told of the "chronoteine camera," one of his latest inventions, and how it may be applied to the study of automobile engines.

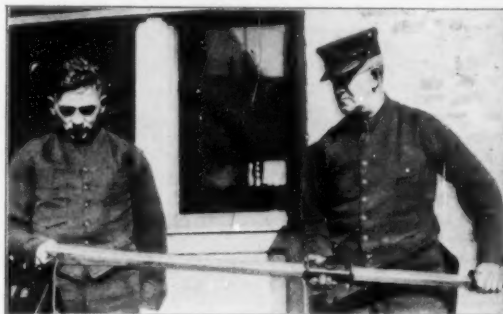
Instead of the 16 pictures a second, taken by the ordinary "movie" camera, or the 128 taken by the "ultra-rapid" camera now frequently used in filming athletic events, the chronoteine takes 3200 pictures a second at its normal rate. If desired, it can be speeded up even further, and take as many as 10,000 a second. When these are projected in the ordinary machine at the speed of 16 a second, the apparent speed of the motion is correspondingly reduced. When taken at 3200 per second, the reduction of speed is 200 times, and at the higher speeds it is of course greater.

In the usual type of motion picture camera, the film is stopped for each exposure, so that it stops and starts 16 times a second. At such high speeds as those employed in the chronoteine camera this is impossible, for the film would be torn to pieces. Therefore it is moved through in a steady stream without stopping at all.

A further difficulty is introduced, because with a single lens, extremely short exposures

would have to be made. Otherwise the picture would be blurred, just as if the object itself were close to the camera and moving at such a high speed. Mr. Jenkins has avoided this difficulty by providing 48 lenses, set in the periphery of a 13-inch disk, which turns at a speed of 4000 revolutions per minute. The film moves

Firemen demonstrating the simple way in which the new device for handling high-voltage wires is operated. This "tong" should prove to be a very valuable addition to the equipment of firemen everywhere because of the fact that, in fighting fires, firemen frequently come in contact with dangerous wires



behind one side of this disk, so that the images formed by the lenses moves right along with the film. In fact, the exposures overlap, as the exposure is begun through one lens before that through the preceding lens is completed. At 3200 exposures a second, each one is about one twenty-five-hundredth of a second in length. With the rapid lenses used, and sensitive film, this



Removing high-voltage wires from the body of an injured man

is easily sufficient for a fully-timed negative in bright sunlight. In the ordinary movie camera, at 16 a second, each exposure is about one thirty-second of a second in duration.

Mr. Jenkins calls attention to the good photographic quality in the pictures, which is unusual in such high-speed studies. "The pictures are true photographic pictures having half-tone values like other motion

pictures, not mere shadowy outlines of grayish silhouettes," he says. "They are made out-of-doors as well as in the laboratory, of large subjects or small subjects, and from a moving vehicle as readily as from a fixed platform.

"The chronoteine camera is an instrument for the study of many problems in

science and engineering, some of which are not possible of accurate determination in any other way. Some additional applications of this instrument which immediately suggest themselves are a study of gun recoil, shell trajectories, and plate impacts; airplane propellers, and landing-gear action; bursting of balloons and air hose; tire action over obstructions; water streams; propagation of flame; engine-valve rebound at high speed; cam-roller jumping; crank-shaft whip; transformer explosions and circuit-breaker arcs; shuttle thread-knots and bobbin action; brake-shoe and draft-gear application; in fact, anything that moves too fast for the eye to follow can be shown slowed down and can be examined in detail at leisure and repeatedly."

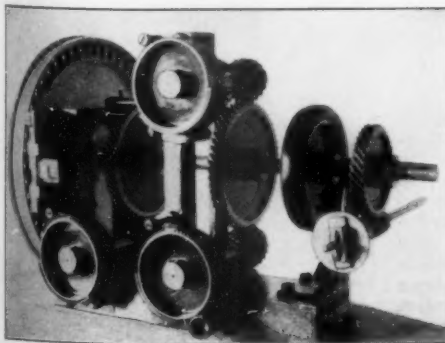
—Science Service.

Device for Handling High-Voltage Wires

A DEVICE for handling of high-voltage wires with safety has been perfected by Arthur Ohlsen, a member of the San Francisco Fire Department. By means of this device, a person can remove highly-charged wires from the body of one who has been shocked or, by means of a quickly detachable life-hook, can pull the body away from a highly charged wire without danger to the rescuer.

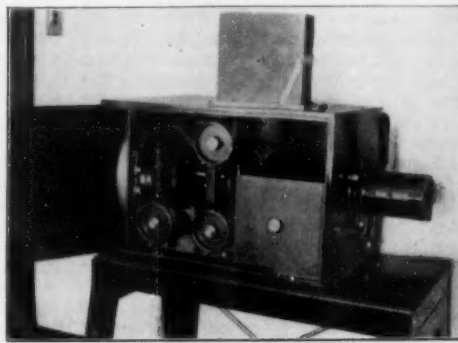
In the construction of the tong, well-seasoned white eastern maple is used. This is impregnated with paraffin to remove all moisture, sap, and acid, thereby rendering it a perfect non-conductor. The device has been tested to 225,000 volts without any leakage.

The tong is about five feet, eight inches in length, and has a bakelite grip at one end



To the left is shown the mechanism of the chronoteine camera—the lens disk, and the air channel to hold the film in focus without any material mechanism touching the film. To the right is the camera itself with which it is possible to make thousands of pictures per second. When the film is then projected at the standard rate of 16 exposures per second, the motion of the object under study is slowed down

Courtesy Society of Automotive Engineers



while at the other end are fingers which grip the wire to be handled. These fingers pass up through the maple pole and are attached to a bakelite grip near the center of the tong. By pushing this grip along the handle the two fingers are opened so that they can be used in grasping the charged wire. When the wire has been grasped properly, the center grip is moved

to the next job, together with the mixing machinery.

Next, the finishing work on the molded house is begun. First of all, the inside of all walls is painted immediately or sprayed with a special mineral waterproof solution. To prevent sweating and to insulate the structure against heat, cold, and sound, the inside of all outside walls is covered

village that is both beautiful and proof against fires, cyclones, and the like.

New Machine for Studying Motion

TO the research engineer and university laboratory director, stroboscopes are not new, as these mechanisms have been used for years in the study of movements too rapid for the eye to follow. However,



With this special machine for mixing concrete, fed by a scoop, it is claimed that from 40 to 60 tons of concrete can be poured in an hour into the set-up steel forms. Relatively few men are required to operate this machine which is said to be capable of mixing concrete for a five or six room house in two hours



along the handle until the fingers are tightened on the wire. Then the operator can handle the charged wire with ease and safety.

New Progressive Method of Concrete House Construction

CONCRETE houses superior to those built by old methods of construction, yet turned out one after the other, as automobiles are made, by progressive assembly, is now possible with the use of metal forms which are the invention of Mr. J. Edward Lambie of Cleveland.

The new molds are composed of light steel units, rolled and shaped for great strength and rigidity, and so designed that they may be set up with great rapidity for molding houses with a wide variety of form and appearance. Speed of construction and variety of design are the salient features of the lamolithic process. It is claimed that seven or eight men can mold two houses a week by the use of these forms and the special concrete mixing and pouring machines. This includes all work from the setting up of forms to their removal after setting of concrete.

The standard form unit is six feet long and nine inches wide and weighs about 40 pounds. Filler units are six inches wide and, when used in combination, render possible a mold of any size in multiples of three inches. The forms for an ordinary six or seven room house can be set up by seven or eight men in one day. One complete story, consisting of walls, floors, partitions, roof cornices, chimneys, and porches is set up at one time, and this is poured in a single operation.

Electrical conduits, boxes, et cetera, are set in place as the forms are erected so that they can be cast in the house mold ready for pulling in the wires.

After the forms are installed, the pouring of the concrete is done with a machine that is also the invention of Mr. Lambie. The mix is prepared according to a secret formula and poured with great speed under pressure. While the slab is being poured it is necessary for two men to follow the pouring to level off accurately and smooth the top side of the slab. The entire pouring process for a five or six room cottage requires only about two hours.

When all concrete has been poured, the concrete is allowed to set, the time for this normally being 24 hours for the walls; and the forms are then taken down and moved

with lamolite, a special insulating material which is claimed to be 80 percent air cells. Following this, the walls are treated with plastic material in any variety of colors and texture. The floors may be simply painted and waxed or covered with linoleum or any approved floor covering. The finishing touches, such as the hanging of doors, the

One of the attractive houses built of concrete under the new plan. The forms for all the walls and floors for this house were first erected and then the concrete was all poured at one time, the result being a monolithic structure which is seamless and sound. Such houses as this, which can be built in a great variety of design and color, size and room arrangement, should be particularly desirable for earthquake or tornado zones

setting of windows, and the installing of plumbing and electric lighting fixtures, are then made.

The house built by this method is more solid than ordinary concrete houses since there will be no seams such as would be left by batch pouring of concrete. It may have an individual, artistic design instead of being simply a box-like structure with attached ornamentation. Such a house can be built much cheaper because of the plan under which it is necessary to work.

The cost of forms, the concrete mixing and pouring machine, and the use of the secret formulae, makes it necessary that houses be built on this plan only by large operators, civic bodies with the interests of the community at heart, or by manufacturers who own their own villages for their workers.

Public-spirited citizens will see in this plan a method of combating the growing tendency toward inferior building in newly-developed sections of their communities. By organizing to build under the Lambie plan, they will also be able, in some measure, to attract permanent desirable residents who would otherwise be unable to purchase a home and settle in their midst. Manufacturers such as the cotton-mill owners of the south, who build homes for their workers, could use this new system to great advantage and have in the end a

a new type recently introduced from France, seems to have several advantages over old types and is attracting wide attention in this country.

Stroboscopes of the past were usually either a rapid shutter or a light-flashing mechanism that could be so timed as to allow instantaneous glimpses of a moving



mechanism. If, for example, the object being studied was a rotating wheel, the shutter opened or the light flashed—according to which was used—every time the wheel made one revolution, so that the eye



Stroborama, showing neon tube in box, and operating mechanism

perceived only the instantaneous position, and the wheel seemed to be standing still. The mechanism could also be so timed that the glimpse of the wheel would come a fraction of a second later each time to give the effect of very slow motion.

But whereas stroboscopes of the past have required semi-darkness for demonstration, this new French machine, the stroborama, may be used in daylight or under ordinary shop conditions due to the fact that it uses a 1000-candle-power light. The light is a neon tube with many bends, arranged in a large box. Thus when it is directed toward a moving mechanism, vision of the object of study is not restricted to one person nor does the spectator need to stand in a certain position; a large group of people standing anywhere in a room may see the test with equal clearness.

In a recently witnessed demonstration, the writer saw a small propeller, rotating

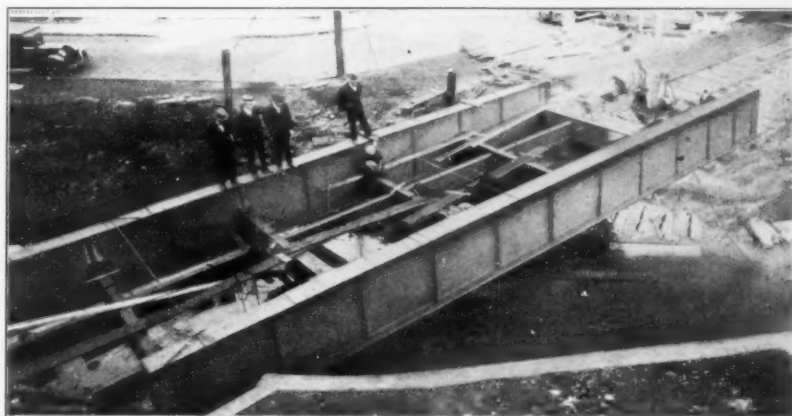
speed; and again, it actually seemed to turn backward. Other tests were made on a cam mechanism, a vibrating string attached to a tuning fork, and a poppet valve. It was interesting to note in this latter demonstration that the springs surged at all times regardless of the fact that the remainder of the mechanism was "held" in a stationary position. Besides this, the valve-lifter and the valve did not follow the profile of the cam.

The stroborama is rated at 1500 watts at 110 or 220 volts, 50 or 60 cycles, single

principle, particularly for use in textile plants, for studying the operation of spinning frame spindles. It is mounted on a small rubber-tired carriage, and the light is in a small insulated box having a convenient handle which extends from the machine on a rubber tube.

New Steel Bridge All Arc Welded

A NEW type of steel bridge that is practically a one-piece structure was completed in Turtle Creek, Pennsylvania,



The new all-welded bridge that is attracting much attention



Photograph of a high-speed poppet valve under the rays from the stroborama, showing spring surge and "jumping" of valve rod

at 2200 revolutions a minute, apparently stand still. The light-flashing controls were then manipulated so that the propeller seemed to be rotating at very slow

phase. The light is flashed by a rotary contact-breaker, constituting the synchronizer, which produces intermittent discharges from a low capacity condenser. This synchronizer is connected to a tachometer so that the speed of wheels, et cetera, which would be unobtainable otherwise, may be measured.

The uses to which the stroborama may be put can readily be seen. It should have great value to engineers, manufacturers, and to university laboratories. Universities, in fact, have evinced a special interest in this machine because of its adaptability to group study, and several have already used it successfully.

Besides the machine described above and illustrated herewith, another and smaller machine has been designed on the same

recently and is attracting widespread interest among railway structural engineers as the first completed all-welded railroad bridge in the world. The bridge consists of smooth continuous beams, joined together by the electric arc-welding process which eliminates rivets and bolts. It spans the historic creek on the Turtle Creek-Linhart branch of the Westinghouse Electric and Manufacturing Company's interworks road. The bridge, 62 feet long, contains only 20 tons of steel. This represents a notable saving in steel and weight over a riveted bridge of similar size whose weight would have been between 25 and 30 tons.

The initial test of the structure was made when a 185,000 pound locomotive steamed across the new one-piece bridge.

Preliminary to the actual raising of the bridge, the huge girders were welded in the shops and made ready to lay. The old bridge was then lifted from its foundations, the new girders placed, all members welded, and the tracks laid. These operations were accomplished in one day and a half. Four arc welders did the work.

In addition to its service on the interworks railroad, this span forms an important shipping connection for railroads operating through East Pittsburgh. The one-piece bridge will be subjected to the most exacting tonnage tests as it was designed to carry the largest generators built at East Pittsburgh. Because of the great weight of these machines, it is necessary to ship them on specially built cars.

Safety Glass for Automobiles

A LARGE percentage of the injuries resulting from automobile accidents are due, not to the smash-up of the car itself, but to the flying glass from windows and windshield. Consequently the adoption of triplex glass this year by two well-known automobile manufacturers and two cab companies has aroused great interest

(Continued on page 469)



This car, using triplex glass for the windshield, was in a bad smash-up. Imagine the driver's danger if glass had scattered

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

A Circular Airport

NEW YORK CITY is working energetically on its plans for a municipal airport at Barren Island. But since the major part of New York's air traffic will come from

ning of the World War, the Air Service had grown, at the signing of the Armistice, to 45 squadrons, 23 balloon companies, and a total of 78,333 men. In spite of all criticisms, the American achievement in the air

those made in Europe. A tangible result of his visit is the arrangement of an international air express service, in which the American Railway Express will co-operate. Except for the transatlantic passage, cities in the United States will now have direct air connections with the capital cities of Europe.

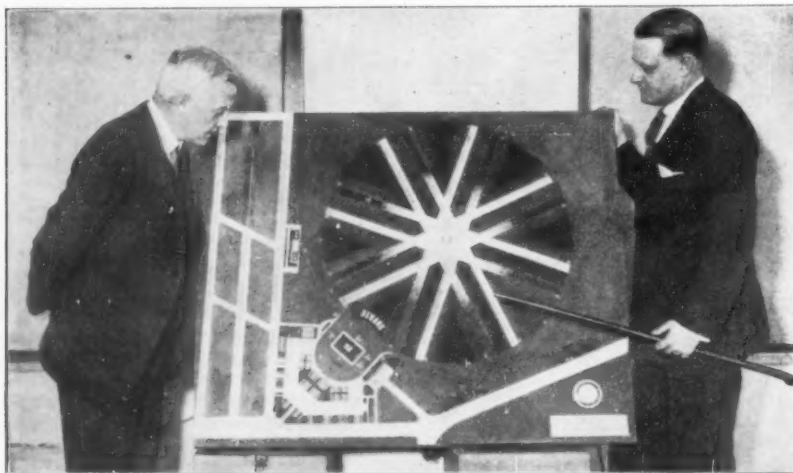
The "K.L.M." selects its pilots from the best aviators of the Dutch Army. Nevertheless, they receive six months special training in actual transport work, flying in dual control ships. A most interesting part of their training is that in blind flying. The window in front of the pilot in training is blackened and a black cloth blocks off his view from either side. He is then in darkness and can only see his instruments. Four hours of such work and the pilot becomes proficient in blind flying. The perils of fog flying then disappear to a large extent.

A Low-powered Racer

THE Schneider Cup winner of last year was equipped with a Napier engine developing something like 1200 horsepower. We have come to think that very high speed must be associated with high power. If we study the De Havilland *Tiger Moth*, there appears another path to high speed, namely, extreme refinement in aerodynamic design and lightness of construction.

The *Tiger Moth* was equipped with a "Green" engine of 130 horsepower only, but it has managed to attain a speed of 187 miles per hour. Fully loaded it weighed only a little over 900 pounds. Wherein lies the secret of this great achievement? In a number of clever points in design.

For high speed, a thin, double cambered wing is probably most desirable. To brace such a wing externally, the designer did not use the usual, somewhat heavy and bulky streamline struts, but only four streamline wires on either side of the fuselage, two above and two below the wing. This type



Design of the circular airport for Newark, New Jersey. The arrangement of the runways will allow landing and taking-off regardless of the wind

the west, many authorities think that the new airport being constructed at Newark, New Jersey, will serve the metropolitan area far better. It is situated in the very heart of the port of Newark, six railroads and numerous highways meet at its site, and it is only 22 minutes running time from Broadway.

In its design, highly scientific methods have been employed, models of hangars and other buildings being shifted about on a board until just the right arrangement was arrived at. Five hundred acres have been set aside for the airport, with 176 acres used for the first unit, and 1,000,000 dollars is being spent on conditioning the field.

A unique and advanced feature of airport design is being incorporated in the plans. The airport is to be circular, with all the buildings entirely clear of the landing field itself. With double runways crossing the center of the field, at 45 degrees to one another, planes can land safely no matter what the direction of the wind may be. The double runways will enable one plane to land and another to make a get-away simultaneously, each in line with the wind, and yet without danger of collision.

"Air Service, American Expeditionary Force"

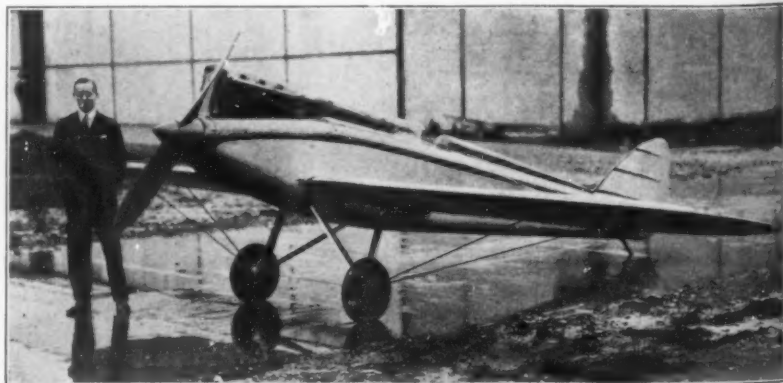
H. A. TOULMIN, Jr., a patent lawyer of distinction in civil life, was chief of the Co-ordination Staff of the Air Service during the war. His book, "Air Service, American Expeditionary Force," (published by Van Nostrand), is a guide to the executives of our air services for years to come.

From practically nothing at the begin-

may be said to have been a stupendous one. But it was accompanied by muddling, indecision, and lack of discipline. The book shows conclusively what a tremendous and complicated task the technical and military organization of an air service really is.

Training in Blind Flying

CAPTAIN ALBERT PLESMAN, managing director of the "K.L.M." or Royal Dutch Air Lines, has recently been on an extended visit to the United States. It is gratifying to learn that he considers our metal propellers, airplane wheel brakes, and several other accessories better than



Captain Broad of the De Havilland Company is here shown standing by the side of the *Tiger Moth*, a plane of only 130 horsepower, yet one which will travel 187 miles per hour by virtue of its excellent aerodynamic refinement

of bracing is by no means new but simply a return to an effective and well tried out plan which monoplane designers might do well to reconsider. The body was reduced to the absolute minimum in its cross-sectional dimensions; it was somewhat wider at the top to accommodate the pilot's shoulders; somewhat narrower at the bottom to accommodate the pilot's feet working probably on a pair of foot pedals.

The wing hinges, generally visible and productive of air resistance as well as losses due to leakage in the gap between wing and body, were carefully streamlined in. Instead of the conventional windshield to break up the upper line of the body, the pilot's cockpit was so arranged that adequate shelter was provided without any windshield projection. The rubber shock absorbers were hidden in the wheel itself. The chassis consisted of only four struts, with side thrust taken care of mainly by the lift wires of the wing truss, which were thus made to serve a dual function. The spinner and the forward lines of the fuselage in general were very neat. A great deal that would be applicable in commercial design might be learned from this small plane.

Seaworthiness of Seaplanes

THE English are a seafaring people. It is quite natural for them to be interested in seaplanes, and in attempting to make giant flying boats into seaworthy craft capable of independent action, and of cruising at will over rough seas. Three of the British Air Ministry's largest flying boats, the *Iris*, *Singapore*, and the *Valkyrie* have recently made a tour of northern Europe for the purpose of demonstrating their durability under difficult conditions. The tour included Copenhagen, Danzig, Helsingfors, and Stockholm, and was highly successful.

It may be interesting to enumerate here a few of the factors which make for seaplane seaworthiness. Size is important. A very large machine is certainly more stable in the air, though less maneuverable than a small single-seater, for example. When on the surface of the water, large size is still more important. With size, goes a greater propeller clearance, so that less damage is to be feared from spray hitting the propeller. With size, we may associate a higher "freeboard" and less liability to swamping in rough water. With large boats, thicker and stronger bottoms may be used without prohibitive structural weight percentages.

With size also, the fore-and-aft stability in the water increases, as does also the lateral stability.

The large seaplanes will also be equipped with several engine units, giving maximum security against power plant failure. Large boats will also enable skilled navigators as well as pilots to be carried, and will be provided readily with powerful sending and receiving radio sets. Mere size does not necessarily mean a greater flying range, at least not beyond a certain limit, but in every other respect, the larger the craft the safer it will be for transoceanic service. If the sensational flights of Lindbergh, Chamberlain, and Byrd are to be the precursors of regular transatlantic services, designers and constructors will have to face the problem of building machines of 100,000 pounds gross weight or even more. They will have many difficult problems to solve; for example, it is quite certain that the control surfaces will be so large as to exceed the manual strength of the pilot, even if the surfaces are carefully balanced aerodynamically, and some form of servo motors, hydraulic or electric, will have to be employed.

The theoretical law of dimensions indi-

cates that a large machine will have to employ a greater percentage of its gross weight for the structure; designers will find and are now finding methods of beating this theoretical law, by the employment of suitable materials, and by refined structural analysis. These and other problems will provide a fascinating field for designers and builders for many years to come.

Hospital Plane Approach

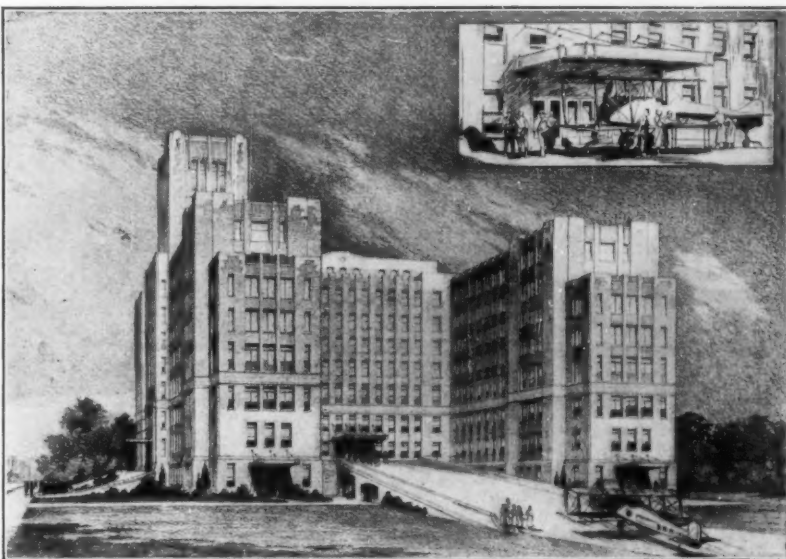
AIRPLANE ambulances are part of the equipment of the air forces of every great country. Fuselages are so arranged that four stretchers or more may be comfortably disposed therein. Large openings in the side permit the stretchers to be put in or taken out with a minimum of trouble. For sick or wounded men, this method of travel is not only the speediest, but in many ways the most comfortable.

In the British campaign in Iraq, 200 wounded men were transported in such air ambulances from almost inaccessible spots to the base hospital at Bagdad. There is no reason why air ambulances should not be utilized in civil hospital work, and quite recently Dr. Alexander Selkin of the Bronx Hospital, New York City, conceived the idea that a special ramp should be constructed as an airplane approach. As the drawings of the proposed hospital show, the ramp will allow quite a big plane to come to the very door of the hospital.

To Build or Not to Build

IN a recent paper presented before the American Society of Mechanical Engineers, Mr. A. T. Stewart stated that there are now in the United States, 651 municipal and 214 commercial airports in operation or proposed, of which only 91 are at present regular stops on established or designated civil air routes.

Many letters come to the Chamber of Commerce of the United States asking the question "What are the advantages of an airport in a city of 8000 to 50,000 inhabitants, and should a city of the size mentioned consider establishing an airport?" The answer is that the building of an airport (Continued on page 461)

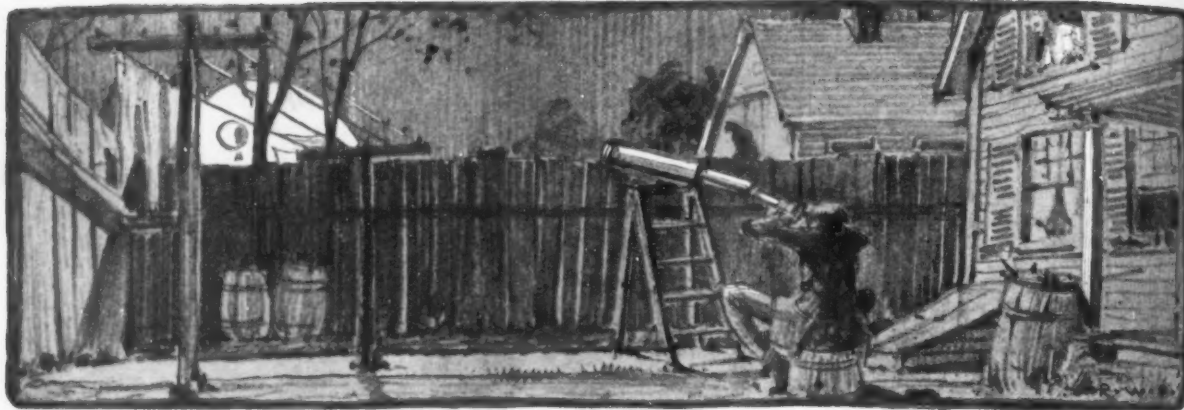


Herbert
Airplane ramp proposed for the Bronx Hospital, New York City, which will allow an aerial ambulance to come to the very doors of the hospital



International Newsreel

The *Valkyrie*, one of the large British flying boats which recently demonstrate their durability under adverse conditions in an extended aerial tour



The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

HERE we amateur telescope makers are, more than 3000 of us, gathered together in our own back yard at last. At the top of the page you see the Back Yard, just as our mentor in telescope making, Russell W. Porter, has pictured it. Here we shall now meet each coming month and here we shall feel altogether more free to disport ourselves in our own natural element than we have been in the remainder of the magazine which is perhaps a bit too formal for us.

The interest in amateur telescope making seems to maintain itself pretty consistently, month by month. The way the telescope editor knows this is by his mail; also by the magazine's sales of the instruction book, "Amateur Telescope Making"—"A.T.M." we call it, for short. It looks as if the hobby would be really permanent in this country—everywhere, in fact, for "A.T.M." has now gone pretty nearly all over the world. Some of the earlier amateurs are now becoming expert and are discovering new ways of doing old things—an encouraging sign.

As we have done each month for almost

two years past, we shall continue to publish descriptions of reflecting telescopes made from "A.T.M.," taking them in order of receipt. We have quite a number of these on hand, but we believe the majority of makers have not yet sent in pictures.



An enthusiast—Mr. Worbois' daughter

Incidentally, not all that did so included themselves in the group. Let's have it understood that an amateur is not out of order when he does this. Other amateurs want to see the maker as well as the telescope, and his countenance always lends added interest.

First of all, this month, comes the description of a telescope made by Victor H. Massey, 517 Mound Avenue, Pasadena, California. It is an eight-inch, with wooden upright, much as described in "A.T.M.," and the maker states that it cost him only 12 dollars, all told, for materials. The parts of the mounting are largely ordinary pipe fittings, and the two necessary motions are made possible by the use of pipe unions.

Another interesting telescope, a six-inch, was made by E. L. Worbois, 127 Adam Street, Tonawanda, New York. Mr. Worbois says everything was done with ordinary household tools. He especially wished portability. The entire telescope weighs only 20 pounds, and folds up for transportation in a car.

More telescopes will be described next month. In future, the full addresses of

persons mentioned in this department will be published unless request is made to the contrary. The hope is that interested amateurs in other places will thereby be led to correspond with one another and the amateur fraternity be brought more closely together. Also, if those who wish correspondence with other amateurs will advise the telescope editor, their names will be published. State pet interests, briefly.

The telescope editor has been advised that the "Telescope Makers of Springfield" plan to hold their annual get-together of amateurs at the usual place, "Stellafane," near Springfield, Vermont, on the Saturday after July Fourth. The only open sesame needed is an interest in telescope making. All are automatically invited. The purpose of these conventions is to become mutually acquainted and to talk shop, and they have been a great success in past years. There is a small hotel at Spring-



Mr. Massey's telescope—easy to make

field, but if last year's get-together was any criterion, nobody will have much opportunity to use it—at least not for sleep. Plan to come this time. By the way, Porter has discovered that the name for this new department of the SCIENTIFIC AMERICAN automatically confers a "B.A." degree on each of us!

The T. Ed.



Mr. Worbois sighting his telescope

Uses for this grainless wood are steadily increasing from New York to Hollywood!

Possesses uniform strength and remarkable workability. Highly resistive to moisture. Very tough and dense. Has a smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large, free sample.

TWO years ago, after a long series of tests and experiments, a modern inventive genius succeeded in producing a wood better, in several ways, than Nature's own material. It was much denser, far tougher, had greater moisture resistance. And it was *grainless*!

This product, known as Masonite Presdwood, has already shown almost unbelievable adaptability in many industries, and the number of its uses is steadily increasing throughout America.

In fact, the trails of Presdwood cross and re-cross endlessly—from breakfast nooks to motor boats, from cooling trays for hot castings to the paneling of beautiful homes, from the packing cases in a New York warehouse to the movie scenery of Hollywood!

This is happening right along

Step into the offices of a great manufacturing plant located in Camden, New Jersey, and you will find that all of its telephone booths are lined with Presdwood.

Out along the highways of Pennsylvania you will again see Presdwood—in the form of advertising signs.

In Pittsburgh, more Presdwood—a large department store ordered 14,000 feet of it just a few weeks ago.

In Cleveland, and other Ohio cities, candy manufacturers are making use of Presdwood for starch trays.

A Wisconsin manufacturer has also standardized on Presdwood—for incubators. A Minneapolis concern is using it in making safety wheels for bathing beaches and swimming pools. Out in Los Angeles, as well as in the East, it is going into concrete forms.

Presdwood is used for bed-room screens and for barbecue stands, for invalid trays and for theatre props, for artists' boards and for display booths. It will give as dependable service for garage doors in a Chicago suburb as for china closets in a Boston residence or for fixtures in a Seattle delicatessen store!

Only a short time ago, the head of a fast-growing American industry sat in his office running an eager hand over the fine, smooth surface of Presdwood. Quickly he decided that it was the very thing he needed, and it is now standard material for the manufacture of one of his leading products.

Similar incidents are happening right along. The simple truth is that you have no idea of what you can really do with Presdwood until you have seen a sample and made a few experiments with it.

The advancement of Presdwood has been especially rapid in planing mills and wood-working plants. Kitchen cabinets, show cases, counters, radio boxes and tension boards, work-bench tops, cupboards, office partitions and shelving—these are but a few of the many additional things which are made of Presdwood. And new uses are being discovered almost every day!

Remember that Presdwood is not only *grainless*, but that it has greater moisture resistance than Nature's own material, is much denser, and is far tougher. Yet it contains no chemical binder; no foreign substance of any kind. It is simply genuine wood torn apart and put together again—genuine wood, and nothing else!

Presdwood is manufactured by exploding fresh, clean chips from guns. This is done at a velocity of about 4,000 feet per second. The long fibres thus produced are then packed into hydraulic flat bed presses and subjected to hundreds of tons of pressure. The finished product is cut by automatic machines into broad smooth boards of uniform thickness.

Advantages of Masonite Presdwood

Masonite Presdwood has an exceptionally smooth, attractive surface on the face side, and requires no paint for protection. It also takes any finish beautifully. It won't crack, check, split or splinter. It shows minimum contraction and expansion.

It contains no grit, and can not damage tools. It can be used on saw, planer, sander, shaper. And it comes four feet wide by twelve feet long.

We urge you to make your own tests and experiments with Masonite Presdwood. Only in this way can you find out what a really wonderful product it is. We will gladly forward you a large free sample promptly on request. Send for it to-day.

MASONITE FIBRE COMPANY

Sales Office: Dept. 1658, 111 W. Washington St., Chicago, Ill.

Mills: Laurel, Mississippi



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PRESWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.



Industries From Atoms

4 Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Chemists Still Fail to Rival Rubber Tree

THOMAS EDISON is trying to develop a process of making rubber from milkweed. His friend, Harvey Firestone, is developing a huge plantation in Liberia.

probably 2500 tons annually, one eighth of Germany's normal consumption. A special plant was erected for the purpose at Leverkusen, using calcium carbide, but the process had to be abandoned after the war as non-commercial. The synthetic rubber,

since been of the utmost significance in processing natural rubber, as well as improving the quality of synthetic rubber. Whether research on synthetic rubber has been able to develop its elasticity in comparison with natural rubber seems doubtful.

Undoubtedly the German dye trust has succeeded in cheapening the costs of the basic hydro-carbons, but natural rubber producers could lower prices without loss, and be strong competitors of a synthetic venture."

Moth-Proofing Fabrics

MANY moth repellents have been used for generations to keep moths out of the family woollens during storage in the summer, but most of these leave disagreeable traces and they only succeed in driving moths away without necessarily killing them or their larvae which may be present at the beginning. To avoid this difficulty, numerous investigators have tried to find materials which could be put into the fibers of the wool in much the same way as a dye attaches itself. Lloyd E. Jackson and Helen E. Wassell at the Mellon Institute of Industrial Research have found an effective material of this kind in derivatives of the alkaloids of cinchona. In reporting the results of their study in *Industrial and Engineering Chemistry*, they say in part:

"Products of the cinchona alkaloids have been shown to meet criteria of excellence heretofore unsatisfied by other moth repellents. They are inodorous; they adhere to the materials to which they are applied; they can be put on evenly like a dyestuff; they are not apparent on the materials treated; they do not dust off, they do not affect undesirably the physical properties



Thomas A. Edison at work in his laboratory at Fort Myers, Florida. The "electrical wizard" is hard at work on a process for producing synthetic rubber

The third of this famous trio of friends, Henry Ford, although stating that "if anybody can make rubber from milkweed, Edison can," is planning a mammoth rubber plantation on a site recently acquired in Brazil.

While these distinguished Americans are working in their respective ways to assure an adequate supply of rubber, the newspapers have recently given widespread publicity to a report that the Germans are ready to make synthetic rubber. These stories originated from an address made by Geheimrat Von Weinberg of the German dye trust at Frankfurt recently, when he said that his organization "will be able to produce easily the raw materials for synthesis of rubber and guttapercha by contact (or catalytic) synthesis," and that application had been made for patents.

Industrial and Engineering Chemistry points out that the scribes of the daily press have jumped at conclusions in intimating the early obsolescence of *hevea brasiliensis*, the rubber tree. What Dr. Weinberg said, and what he meant, was that he can produce the raw materials for rubber synthesis. The finished product, or the actual synthesis, is still, in the opinion of most experts, somewhat remote from commercial practicability.

"Fritz Hoffman, of Breslau, is at present identified with advanced research on synthetic rubber, and is believed to be engaged in producing synthetic isoprene from p-cresol and passing it through B-methyladipic acid. During the war synthetic rubber was produced in Germany at the rate of

moreover, decomposed in the air, and was not susceptible to vulcanization.

"However, Professor Hoffman and his colleagues found the organic accelerators and refiners, the 'vulcacite', capable not only of permitting vulcanization, but of rendering the product insensitive to light and air. These auxiliary products have



Spraying upholstered furniture with a moth-proofing solution

Your favorite gasoline
+ ETHYL =
 Elimination of "knock"
 More Power
 Quicker Pick-up
 Less Shifting
 Cooler Engine



LEADING oil companies throughout the United States and Canada are offering gasoline in two forms.

The first is straight motor gasoline. The second is motor gasoline to which has been added "Ethyl" fluid. This superior fuel is called Ethyl Gasoline.

"Ethyl" fluid, containing tetraethyl lead, controls the combustion rate of gasoline, thereby eliminating "knock" and giving added power for tough hills and heavy roads, greater flexibility, quicker pick-up and all round better performance. As for high compression engines—they were made possible through Ethyl Gasoline!

Drive to a pump which bears the "Ethyl" emblem, shown at the right. The price of Ethyl Gasoline will be merely the price of good motor gasoline, plus the few extra pennies the "Ethyl" ingredient costs. The small premium is insignificant when compared with the added performance.

ETHYL GASOLINE CORPORATION

25 Broadway, New York City • 56 Church St., Toronto, Ont., Can.

ETHYL GASOLINE

Ethyl Gasoline is the "anti-knock" (high compression) fuel by which other gasolines are measured.



Two different types of gas masks for protection against poison gas. Such masks as these could be used in the test suggested in these columns

of textile fibers; they can be made soluble in inexpensive organic solvents, such as petroleum naphtha, as well as in water; they are nontoxic to human beings; they are valuable clothes-moth repellents; and they are economical to use industrially."

"In addition to the laboratory investigation, practical tests have been made with cinchona alkaloid products which have consisted of treating moth-infested clothing, rugs, and furniture with cinchona alkaloid compounds dissolved in such solvents as water, petroleum naphtha, and carbon tetrachloride, the last-named because it is non-flammable. Clothes-moths were destroyed and did not re-enter articles treated by immersion in these solutions, followed by centrifugal extracting, drying, and exposure to the insects. Similar results were obtained with articles sprayed with petroleum naphtha solutions. Furniture, rugs, and hangings were treated in moth-infested homes to determine the effectiveness of the various ways of using the cinchona alkaloids as moth repellents. The conclusion drawn from a number of tests of this nature was that the cinchona alkaloids or their compounds in either water or petroleum naphtha solution are commercially suitable for treating materials

by immersion in or by spraying with the solution.

"Since this conclusion was drawn over a year ago, more than 4000 gallons of cinchona alkaloid solutions have been applied to articles of wearing apparel, furniture, et cetera, under commercial conditions in the dry-cleaning plants of members of the Mundatechnical Society. Many of the articles treated were moth-infested when received. They were all guaranteed to be moth-proofed and free from moths after treatment. Not one complaint has been made by any of the many owners of the articles treated. Four thousand gallons of the solution are sufficient to treat 160,000 pounds of wool, feathers, or fur. The plants in which the work was done are located in eight large cities of the eastern, southern, and midwestern parts of the United States.

"The utility of the process in other fields is apparent. As a spraying solution for household use, the value of high flash-point petroleum naphtha solutions of the cinchona alkaloids is obvious. The process can readily be made applicable for meeting the moth-proofing requirements of a wide range of wool, feather, and fur industries, inasmuch as some of the many compounds

and derivatives of the cinchona alkaloids are soluble and therefore usable in almost any solvent desired. The process can be readily adapted to treating upholstery materials, blankets, suitings, et cetera."

A Test of Chemical Warfare

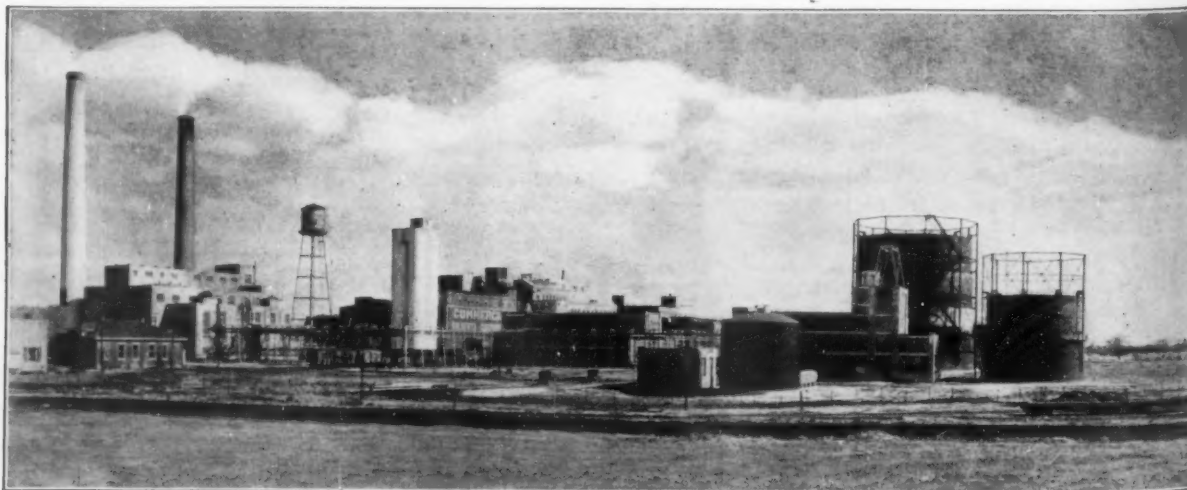
PEOPLE generally are more willing to be led astray by preconceived prejudices than to think things out and adopt proved facts as their mental guideposts, according to Dr. Harry N. Holmes, of Oberlin College, speaking before a recent meeting of the American Chemical Society. Dr. Holmes proposed as a solution for many of our pressing national problems the general adoption of the experimental methods of science in all human activities.

Advocating a research attitude of mind for the prominent citizens as well as for scientists, Dr. Holmes said: "Not only in science but in politics and other subjects as well we should observe and classify the facts, then explain these facts with the theory, and next test the theory by the number of applications, and finally, use these tested theories to predict further behavior. In earlier ages our ancestors did not reason very well about mere coincidences, and so, ridiculous superstitions have persisted through thousands of years.

"Perhaps the greatest need in research training of the public is in connection with gas warfare. We have a very general feeling that gas warfare is devilish, brutal, and should be abolished. Here is a fine illustration of the need of first getting the facts and comparing them. The Surgeon-General of the United States reports officially that in the American army during the World War 24 percent of all the casualties caused from wounds and other agencies than gas died, while only 2 percent of the gas casualties died. The public in general has not troubled to get these facts although they have been easily available. The natural conclusion is that gas warfare, although brutal like all warfare, is really much less brutal than other types of fighting.

"In disputing this theory, we are asked what about civilian populations. Would not airplanes drop gas bombs on defenseless citizens and exterminate whole populations? The final step in scientific reason-

(Continued on page 464)



The huge plant of the Commercial Solvents Corporation, located at Peoria, Illinois. See page 464

ECONOMY



ECONOMY gets right down to dollars and cents. When economy goes beyond initial price and makes itself felt in operating and maintenance costs throughout a long truck life, it points the sure road to profits.

Low operating costs, dependability, power and speed stand out boldly in the experiences of the hundreds of thousands of operators of Graham Brothers Trucks and Commercial Cars And the economy becomes most complete and convinc-

ing when the extremely low initial prices are noted—and the fact that similarly priced repair parts and service are available from Dodge Brothers Dealers . . . *always* and *everywhere*.

Safety, driver comfort, ease of operation, fine appearance, complete trucks to fit any business . . . all these add their weight

in influencing seasoned operators to purchase more than Sixty-five Million Dollars worth of Graham Brothers Trucks and Commercial Cars a year.

2-TON \$1595

6-cylinder engine, 4-speed transmission, 4-wheel brakes (Lockheed Hydraulic).

1½-TON \$1245

4-speed transmission, 4-wheel brakes (Lockheed Hydraulic).

1-TON \$895

¾-TON COMMERCIAL - \$670
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½-TON PANEL DELIVERY CAR \$770
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Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Radio Patents Before Marconi

ONE of our readers, Clarence L. Friend, has sent us a clipping regarding radio patents which were issued 24 years before Marconi's first English patent. This is quite true, and due credit should be given to Mahlon Loomis who patented a transmission and reception device on July 30, 1872. Loomis, however, made use only of the difference of potential which exists between the earth and upper strata of air. He attempted to interest financial aid in his patent but failed. Marconi, whose first patent was taken out in 1896, succeeded in commercializing his system where Loomis and others had failed.

Light-socket Aerials

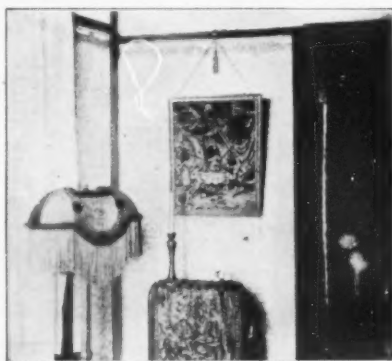
MANY questions have come up relative to the use of so-called light-socket aerials which consist of a small condenser inserted in the circuit between the house-lighting line and the radio receiving set, thereby making use of the electric lighting main as an aerial. That these substitute aerials are satisfactory for use in many locations is testified to by the fact that there are many of them in everyday use. However, a good many radio fans ask whether or not such a device draws current from the lighting line. The answer is that, in a properly designed and correctly constructed light-socket aerial there is absolutely no current drain from the lighting lines.

Transformer Device Protects Loudspeaker

THE present tendency to develop quality and power in audio amplification simultaneously by the use of the UX-171

power tube and a "B" eliminator supplying excessively high voltages has given rise to a possible evil, the remedy for which should be applied as a preventive rather than a cure.

Radio engineers explain that loudspeakers are generally actuated by a highly sensitive electro-magnet equipped



One of the latest types of loudspeakers to appear on the market is illustrated above. It is covered with a framed tapestry, and completely concealed. Hanging on the wall, it is always out of harm's way

with coils wound with very fine wire. Most of the coils can withstand 135 volts "B," but when 180 volts or more are used, the coils are severely taxed. Then the loudspeaker chokes and distortion is noticed, or the coils may be burned out or the magnets demagnetized.

To overcome these conditions, manufacturers have developed output transformers to be connected across the output of the receiver, thus preventing excess amperage from reaching the loudspeaker.

Such a device improves the tone quality and reduces the drain on the "B" source of supply.

Outlawing Radio Interference

GOOD radio programs are so frequently spoiled by man-made static that the town of Fairfield, Iowa, has recently passed a city ordinance which makes it a punishable offense to create interference with radio reception. A fine of 100 dollars or 30 days in jail has been set as the punishment for violation of the ordinance, the text of which reads:

"It shall be unlawful for any person to operate any instrument, device or machine of any kind whatsoever, the operation of which shall cause electrical interference with radio reception, within the city limits of the city of Fairfield, Iowa, between the hours of 12 o'clock noon and 12 o'clock midnight, on any day after the taking effect of this ordinance, save and excepting only such as may be necessary in making X-ray pictures or examinations in emergency cases of physical injuries."

Goal Far Ahead

FOR the most part the radio laboratories at the present time are engaged on the problems coming under the following heads: battery eliminators; improved loudspeakers; and mono-control receivers, according to Dr. Lee de Forest.

"Although the names of the battery eliminators now on the market are legion, few, if any, of these are yet entirely satisfactory," said Dr. de Forest recently. "With the rapid growth in popularity of the power amplifiers requiring larger plate voltages and currents, the problem of 'B' battery supply, to meet the requirements



In the radio control room of the Pennsylvania Hotel, New York City. B. G. Sullivan is shown in charge



Radio outlets have been placed in every room of the Statler owned hotels. The guests have a choice of two different programs between 10 A. M. and midnight. In the main control room is the radio receiving apparatus

acceptable

Not until the last vestige of dandruff is gone can you be considered a fastidious person, acceptable socially.



Dandruff? Not a trace!

If you, or any member of your family have the slightest evidence of dandruff, we urge you to try this treatment, which has benefited thousands:—

Simply douse Listerine, full strength, on the hair. Vigorously massage the scalp forward, backward, up and down. Keep up this treatment systematically for several days, using a little olive

oil in case your hair is excessively dry.

You will be amazed at the speed and thoroughness with which Listerine gets rid of dandruff. Even severe cases that cost-

LISTERINE

—the safe antiseptic

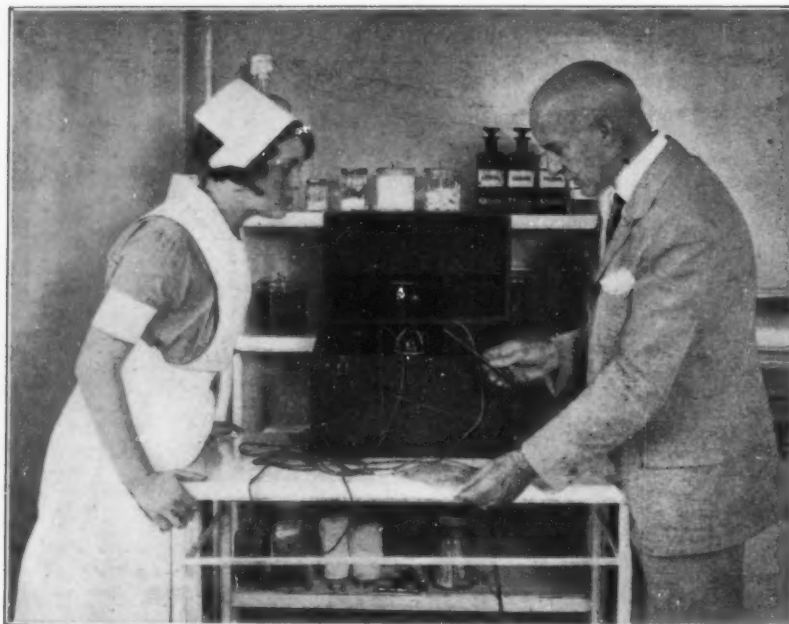
ly so-called "cures" have failed to improve, have responded to the Listerine method. We have the unsolicited word of many to this effect.

The moment you discover dandruff, use Listerine at once—and repeatedly.

LAMBERT PHARMACAL CO.,
ST. LOUIS, MO., U. S. A.

You'll like it

Listerine Tooth Paste is as refreshing as it is effective, and but 25c a large tube.



Underwood & Underwood

The "radio knife" introduced by the Jackson Park Hospital in Chicago. Operating at 3,000,000 cycles per second, it is said to cut flesh without burning

of radio frequency, detector and power amplifier voltages, is far from solved. A soft tube in the set may completely upset the voltages supplied from the eliminator for other tubes in the line. The desirability of using several tubes, the filaments of which cannot properly be connected in series, renders the elimination of the 'A' battery more difficult. Many more or less successful solutions of this problem by the use of raw alternating current on the filaments, or by means of heater elements distinct from the cathode emitter, are already on the market, but it is yet too early to say that any of these are thoroughly satisfactory. Certainly an army of clever radio engineers are still busy on this problem, for the goal to be attained is highly attractive, and it is a safe bet that the storage battery will eventually be completely eliminated.

"In the meantime, small storage batteries with trickle chargers are supplying the requirements of many sets, but this arrangement is at best a palliative, a stop gap, toward the ideal solution. Anything even remotely 'wet' must be eliminated from the radio set of the future. Rapid progress is being made along these lines of battery elimination, and the industry has every reason to feel encouraged.

"As to loudspeakers, every acoustic engineer admits that a perfect loudspeaker does not exist. Many will also admit that the fundamental principle on which the perfect loudspeaker will operate has not yet been developed. Personally, I do not believe that it will ever be attained by means of any type of diaphragm device, whether this be a cone or a flexed membrane."

Alternating-current Tube Control

THE new alternating-current vacuum tubes of the 227 and 226 type are comparatively critical as to filament voltage and are greatly affected by any line fluctuations or inaccuracies in transformer construction. It is, therefore, preferable to protect these filaments by means of a ballast resistance.

A unit suitable for this work has recently been put on the market by Daven Radio Corporation, of Newark, New Jersey. It comes in two sizes, the AC 26, and the AC 27, for the 226 and 227 types of tubes respectively.

It is said that when these filament resistances are employed, a 20-volt line variation gives a filament fluctuation of only .17 volts.

Automatic Announcer

A PATENT has been granted on a radio instrument capable of broadcasting the course, speed, and name of vessels at sea. The inventor is Elmer Sperry, of Brooklyn, New York.

The motor-operated device is a cylindrical machine, designed for connection with the compass of the vessel. As the

compass gives the position of the ship, impulses are sent out by radio to shore stations in communication with the ship. Similarly, the unit is geared to the propellers of the vessel and the speed of the ship is ascertained from this connection. The device also sends out the name of the vessel, a series of dots and dashes being broadcast to spell the vessel's name.

Filament Resistances

ELECTRIFIED receiving sets are often equipped with center-tap filament resistances in order to minimize the hum. These resistances range in value from two to 60 ohms and it is necessary that they be tapped in the exact electrical center if their efficiency is to be as great as possible.

A new wire-wound center-tap resistance has recently been put out by the Daven Radio Corporation, of Newark, New Jersey. The tap is as close to the electrical center as it is physically possible to make it, and this is made doubly sure by the manufacturing method. The resistance is wound from each end inward, with the two matched windings connected at the midpoint. These resistances are available in sizes of 10, 25, and 60 ohms.

Cure For "Motor-boating"

A FEW simple alterations in resistors will often eliminate completely the trouble known as "motor-boating" in resistance-coupled audio-amplifiers where such amplifiers are utilized in connection with "B" eliminators, according to the Aerovox Wireless Corporation. It is pointed out that if the amplifier is the standard three-stage unit it will incorporate a .1 megohm plate-coupling resistor in the first, second and third stages, and grid leaks of .1 megohm, .5 megohm and .25 megohm respectively in the first, second and third stages. The changes suggested are as follows:

The plate-coupling resistance for the first audio stage should be a .1 megohm or a .5 megohm unit. The grid leak for the first audio stage should be a .25 megohm unit. The second plate-coupling resistor should



Professor J. A. Fleming, of Fleming valve fame, who has been awarded the Faraday Medal by the council of the Institute of Electrical Engineers

be .25 megohm and the second grid leak .1 megohm, the plate-coupling resistor for the third stage .25 megohm, and the third grid leak .1 megohm.

A higher plate voltage is recommended for the detector than is applied to the amplifiers. The coupling capacity should be .05 microfarad.

"Band Selector" in New Receiver

MANY present-day radio receivers strive toward selectivity as their most prominent feature and as a result, the reproduction from such sets is often far from pleasing. This is due to the fact that the sets are so sharp in tuning that they cut off the side bands which are necessary to the proper reproduction of a radio program. A receiver which has recently been announced by its inventor, Dr. Frederick Vreeland, does not do this but still is amply selective for ordinary use. It incorporates a circuit known as the "band selector" which brings into use a frequency band 20 kilo-



Wide World

Another automatic radio receiver has been designed and built by Harry N. Marvin, of Rye, New York. Tuning is accomplished by pressing buttons or throwing levers, instead of turning dials as is the usual method of tuning a radio set

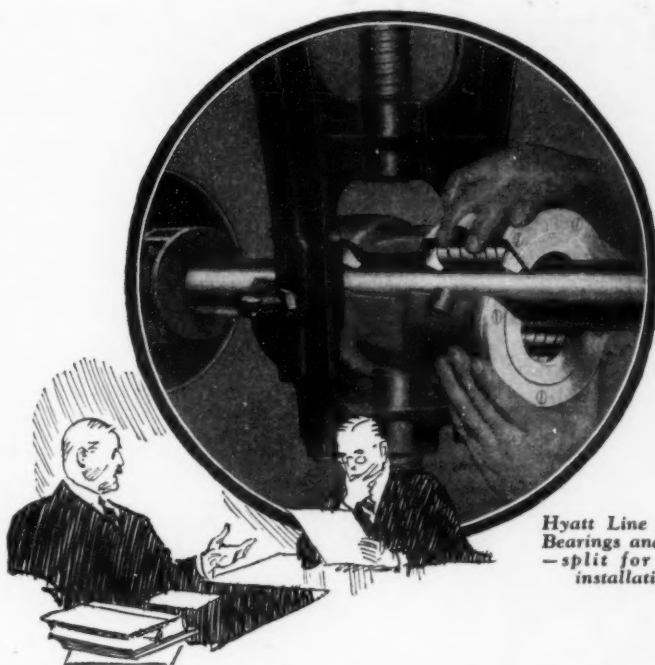
cycles wide with a sharp cutoff at each end. This, compared with the ordinary tuning of a sharp receiver with its steep peak, passes on to the audio-amplifier and loudspeaker, the fundamental wave and both side bands. The result is said to be more natural reproduction.

Taylor Awarded Liebmann Prize

DR. A. HOYT TAYLOR, of the Radio Division of the United States Naval Research Laboratory, was awarded the Morris Liebmann memorial prize for 1927. This was done in recognition of his investigations on radio transmission on the short wavelengths. The award carried a medal and a check for 500 dollars.

Guaranteed Reception

SO faithful are the short waves from broadcasting stations in Schenectady in reaching the British Isles that an English set-manufacturer, in his catalogue, guarantees that his short wave receivers will detect stations 2XAD or 2XAF, Schenectady, or money will be refunded.



Hyatt Line Shaft Bearings and Box—split for easy installation

Power-saving is profit-saving

POWER consumption may suddenly jump from normal to an alarming new high . . . perhaps the result of plain bearings chafing on a line shaft . . . putting a crimp in the profits.

For power-waste is profit-waste. Belts, shafts, gears and motors that carry an unfair drag have a grim way of registering their complaint.

Power-saving, on the other hand, is profit-saving. And power-saving has been the sole concern of the Hyatt Roller Bearing Company for 37 years.

Replacement of power consuming plain bearings is not expensive . . . Hyatt Line Shaft Bearings are split for easy installation . . . and their maintenance is only a matter of lubrication 3 or 4 times a year.

Executives whose duty it is to reduce power-waste . . . whether it be in line shaft or other industrial applications . . . railroad, farm or automotive equipment . . . will recognize the wisdom of conferring with Hyatt engineers.

HYATT ROLLER BEARING COMPANY
Newark Detroit Chicago Pittsburgh Oakland

HYATT

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

Applied Science for the Amateur

A Department Devoted to the Presentation of Useful Ideas.

Material of Value to All Will Be Found Here

Model Plane That Runs on Compressed Air

FOR some months past, we have been running a series of articles, prepared by the Playground and Recrea-

tion Association of America, dealing with the construction of model airplanes. With this issue, we conclude the series by detailing a model driven by compressed air.—The Editor.



What is claimed to be the first model airplane airport in the world was recently opened at Los Angeles. Here are a group of model plane enthusiasts gathered for a competition at Hawley playground, site of the "airport"

tion Association of America, dealing with the construction of model airplanes. With this issue, we conclude the series by detailing a model driven by compressed air.—The Editor.

THERE are available several descriptions of compressed air engines for use in model aircraft, but probably the simplest of all is that contained in "Model Airplanes and Their Motors," by George A. Cavanaugh. However, this book is hard to get, so we reprint the information in the following paragraphs.

"To make a simple two-cylinder opposed compressed-air power plant, as illustrated in Figure 1, it is not necessary that the builder be in possession of a machine shop. A file, drill, small gas blow torch and a small vise comprise the principal tools for the making of the motor.

"The first things needed in the making of this motor are cylinders. For the making of the cylinders, two fishing rod ferrules, known as female ferrules, are required. And for the heads of the cylinders, two male ferrules are required. Such ferrules can be secured at most any sporting goods store. The female ferrules should be filed down to a length of two inches, cut down on one side a distance of three quarters of the diameter, then cut in from the end as shown in Figure 7. When this has been done, the two male ferrules should be cut off a distance of one eighth of an inch from

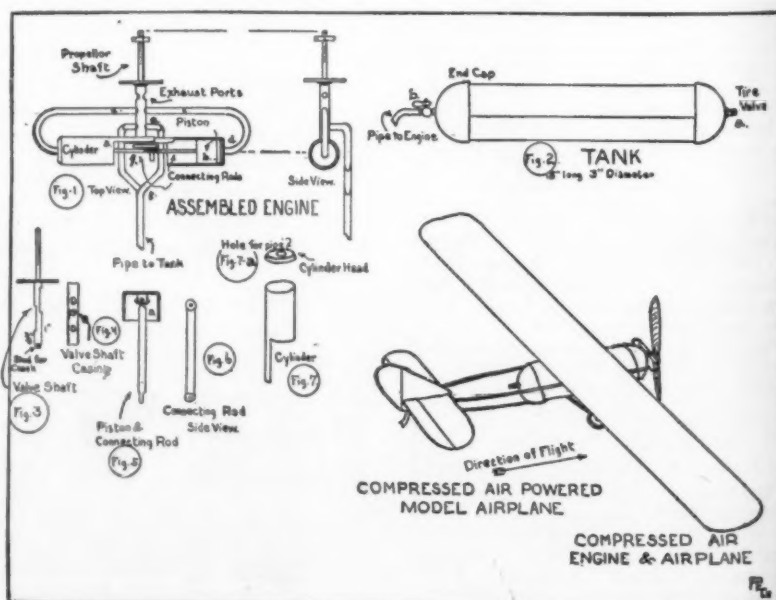
the top, as shown in Figure 7a, to serve as heads for the cylinders. A hole one eighth of an inch in diameter should be drilled in the center of each head so as to enable the connecting of the intake pipes. By the

use of soft wire solder, the heads should be soldered into the ends of the cylinders as shown in Figure 1d.

"The pistons should now be made; for this purpose two additional male ferrules

are required. These should be made to operate freely within the cylinders by twisting them in a rag which has been saturated with oil and upon which has been shaken fine powdered emery. When they have been made to operate freely they should be cut down one half inch from the closed end as shown in Figure 5a. For the connecting rods, two pieces of brass tubing, each one eighth of an inch in diameter by one and one quarter of an inch long, are required, and, as illustrated in Figure 6, should be flattened out at either end and through each end a hole three thirty-seconds of an inch in diameter should be drilled. For the connecting of the piston rods to the pistons, studs are required, and these should be cut from a piece of brass rod one quarter of an inch in diameter by one half of an inch in length. As two studs are necessary, one for each piston, this piece should be cut in half, after which each piece should be filed in at one end deep enough to receive the end of the connecting rod. Before soldering the studs to the heads of the pistons, however, the connecting rods should be joined to the studs by the use of a steel pin which is passed through the stud and connecting rod, after which the ends of the pin are flattened, to keep it in position as shown in Figure 5a.

"For the outside valve mechanism and also to serve in the capacity of a bearing for the crankshaft, a piece of brass tubing one quarter of an inch in diameter by one and one half inch long is required. Into this should be drilled three holes, each one eighth of an inch in diameter, and each one half of an inch apart as shown in Figure 4. Next, for the valve shaft and also propeller accommodation, secure a piece of three sixteenths inch drill rod, two inches long. On the right-hand side of



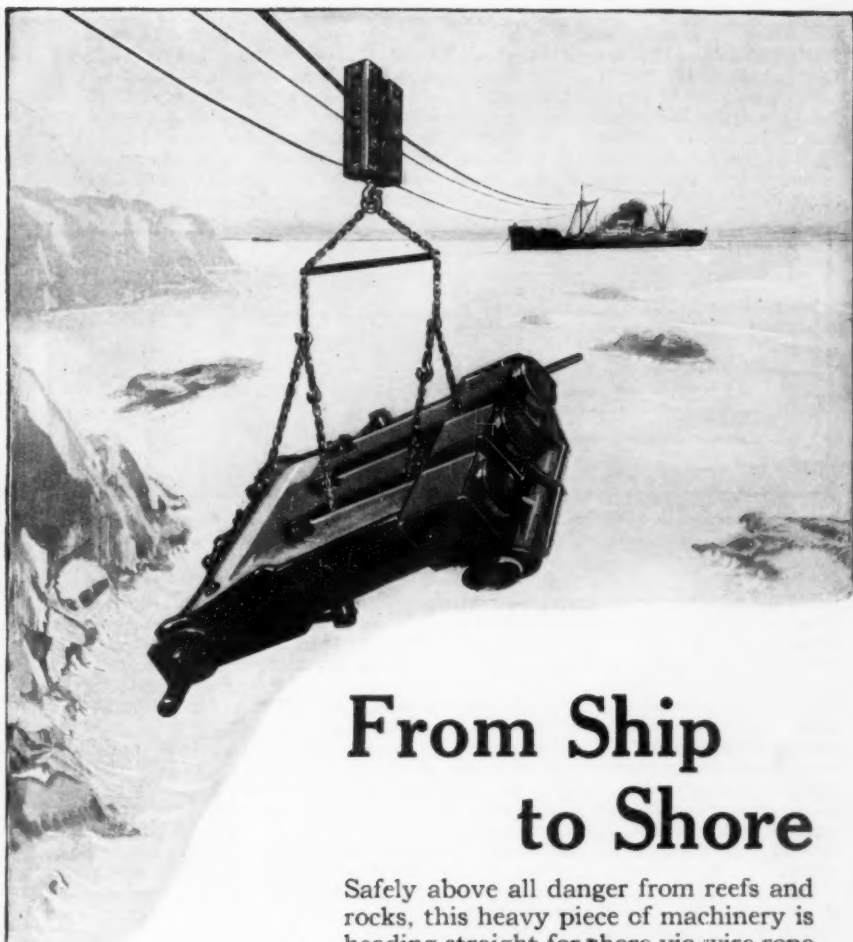
the valve shaft, as shown in Figure 3, a cut one thirty-second of an inch deep by one half inch in length is made one inch from the end. Another cut of the same dimensions is made on the left side; this cut is made at a distance of three eighths of an inch from the stud end.

"As shown in Figure 1f, the crank throw consists of a flat piece of steel, three thirty-seconds of an inch thick, three eighths of an inch in length by one quarter of an inch in width. At each end of the crank throw a hole three thirty-seconds of an inch in diameter should be drilled, the holes to be one half inch apart. Into one hole a piece of steel drill rod three thirty-seconds of an inch in diameter by one half inch long is soldered, to which the connecting rods are mounted, as shown in Figure 1f. Into the other hole the stud end of the crank throw is soldered.

"Before making the tank it is most desirable to assemble the parts of the motor, and this may be done by first fitting the pistons into the cylinders as shown in Figure 1b, after which the cylinders should be lapped one over the other and soldered as shown in Figure 1a. When this has been done, a hole one quarter of an inch in diameter should be drilled half way between the ends of the cylinders, and into this hole should be soldered one end of the valve casing shown in Figure 4. For the inlet pipes as shown in Figure 1c, secure two pieces of one eighth inch brass tubing and after heating until soft, bend both to a shape similar to that shown in Figure 1c. When this has been done, solder one end to the end of the cylinder and the other in the second hole of the valve-shaft casing. The valve shaft should now be inserted in the valve-shaft casing and the connecting rods sprung onto the crank throw as shown in Figure 1f. To loosen up the parts of the motor which have just been assembled, it should be filled with oil, and, by tightly holding the crankshaft in the jaws of a drill the motor can be worked for a few minutes.

"The tank is made from a sheet of brass or copper foil 15 inches by 10 1/4 inches by 1/100 inches thick. This is made in the form of a cylinder, the edges of which are soldered together as shown in Figure 2. Sometimes this seam is riveted every half inch to increase its strength, but in most cases solder is all that is required to hold the edges together. For the caps, or ends, the tops of two small oil cans are used, each can measuring three inches in diameter. To complete the caps, two disks of metal should be soldered over the ends of the cans where formerly the spouts were inserted, the bottoms of the cans having been removed. The bottom edges of the cans should be soldered to the ends of the tank as shown in Figure 2.

Into one end of the completed tank a hole large enough to receive an ordinary bicycle air valve should be drilled, (Figure 2a). Another hole is drilled into the other end of the tank, into which is soldered a small gas cock to act as a valve, (Figure 2b). This should be filed down where necessary, to eliminate unnecessary weight. To connect the tank with the motor, a piece of one eighth inch brass tubing five inches long is required, one end of which is soldered into the hole in the valve-shaft casing nearest the cylinders, as shown in Figure 1e. As shown in Figure 1g, a hole one eighth of an inch in diameter is drilled in one side of this piece, but not through, in the bend near the tank. Another piece of brass tubing one eighth of an inch in di-



From Ship to Shore

Safely above all danger from reefs and rocks, this heavy piece of machinery is heading straight for shore via wire rope—Yellow Strand Wire Rope.

This marvelous cable with one strand of yellow, is safety insurance of the highest order—it's so strong, so absolutely dependable.

Play safe. Write "Yellow Strand" into your wire rope requisitions when a heavy duty cable is required. Then you'll be safe.

This pioneer wire rope company also makes all standard grades of wire rope, for all purposes.

BRODERICK & BASCOM ROPE CO.

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Authorized Dealers in all Industrial Localities

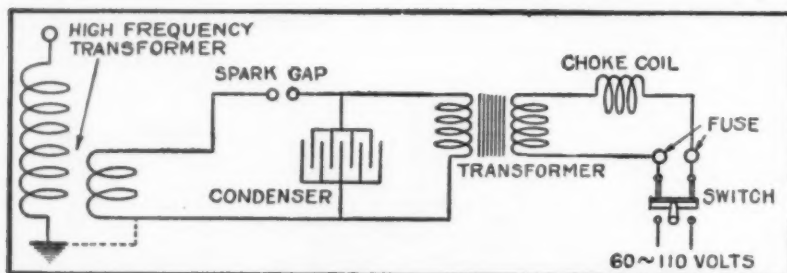
Yellow Strand WIRE ROPE

Motorists

You need a Basline Autowline in your car for emergencies. Made of 3/4-inch Yellow Strand wire rope with patented snap hooks for quick attaching. Very strong but small enough to coil flat under a cushion. Ask your accessory dealer.

ameter is required to connect the bend with the casing. The other end of the five-inch pipe is soldered to the cock in the tank, thus completing the motor.

"In conclusion, it is suggested that the builder exercise careful judgment in both the making and assembling of the different parts of the motor in order to avoid unnecessary trouble and secure satisfactory results."



The circuit diagram of the high-frequency apparatus described in these columns. Below is a photograph of the instruments made by the author

Another source for the tank ends is found by taking apart a brass bed post. These are made in two pieces which are either soldered or pressed together. Bed-post balls have the advantage of being lighter than oil-can ends. A form which tapers passes through the air a great deal easier than one which is of the same dimensions throughout. Therefore, in order to secure a more airworthy model, some contestants may prefer to use different sized ends for their tank, joined by a tapering tube constructed in the same manner as that recommended in the foregoing article.

The drawing shows a typical compressed-air driven model. As will be noticed, the tank is placed longitudinally in the body where it not only presents the least resistance to flight but where its shape carries out the idea of the fuselage of a man-carrying airplane. This drawing is given merely as a suggestion, and the engine can, of course, be adapted to other types of models. When the writer made the accompanying drawing, he had in mind a model with wings of 48-inch span and eight-inch width fastened to a frame 30 inches long. The span is the maximum allowed in tournaments and it would not be wise to make a compressed-air model a great deal smaller than this because of the necessity of having sufficient area to support the engine in flight.

Compressed-air engines are energized by filling the tank with air by means of a tire pump. In doing this, the tank should not be filled to such a pressure that it will burst. If the tank has been well made in accordance with the above description, it should be able to hold a pressure of 25 pounds per square inch. The pressure can be ascertained by the use of an ordinary tire gauge. It is obvious that the cock on the tank is turned off while the tank is being pumped up and turned on when the model is ready for flight.

Apparatus for High-Frequency Experiments

SOME of the most spectacular and interesting experiments with high frequency can be performed with apparatus very easily made and within the means of any pocketbook.

The first important part is the step-up

transformer; one of one quarter to one half kilowatt, giving from 5000 to 10,000 volts at the secondary. One that will answer well can be made as follows:

From the salvage department of the local power company obtain enough core laminations to make a core one and three quarter inches by one and three quarter inches by 12 inches long. Insert a sheet of thin waxed paper between each lamination

and when all is assembled, clamp in a vise and bind together tightly with friction tape.

Make a wooden form the same size as the core; bend around this a sheet of insulating micanite or one sixteenth inch fiber five inches long and wind on the primary of 325 turns of Number 14 SCE wire; shellac and tape the coil.

For the secondary you will need about three pounds of Number 34 SCE wire. On the form build up an insulating tube five inches long and at least one quarter of an inch thick, preferably of micanite; on this, in the same direction as the primary, wind the secondary coil closely and evenly in layers four and one half inches long, with a sheet of thin waxed paper between each layer. You will need at least 17,000 turns on this coil, which will be about 70 layers. Use waxed paper five inches wide to allow one quarter of an inch overlap at each end of winding. When finished stand this coil on end and pour on it all the hot wax that it will absorb.

Cut two boards six inches by six inches, one, one inch thick and the other one half inch thick, and cut a hole in the center of each to a sliding fit for the core. Use the thick one for the base, by inserting the core tightly. Then slip the secondary coil down over the core and fill up any space by tightly wedging with thin strips of fiber or wood. On this lay the one half inch board, then the primary coil and wedge this to the core securely. The necessary terminals can be put on the corners of the center or thin board.

The condenser is of the glass plate type. Very satisfactory glass can be obtained from the discarded negatives of a photographic studio, size eight inches by ten inches. These can be easily cleaned by soaking the plates for 15 minutes in a strong warm solution of common sal soda.

About 25 such plates will make a condenser of sufficient capacity. You will also need about 24 plates of Number 30 gage sheet brass or heavy tinfoil cut to size six and one half inches by eight and

one half inches with a lug on one end of each. Assemble the condenser in a wooden box with a hole in each end for the lugs.

The spark gap can be made from two adjustable brass knobs with faces about three quarters of an inch, mounted on a piece of bakelite and covered with a glass or fiber tube.

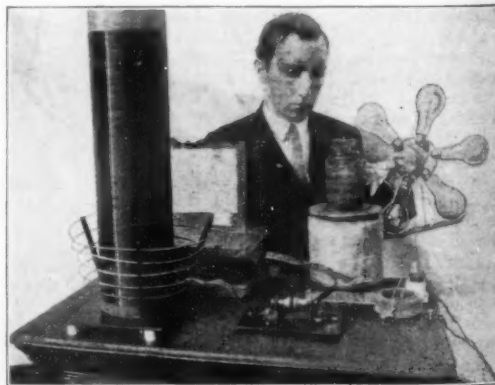
The high-frequency primary consists of six turns of Number 10 bare wire on a skeleton form that can be made from a piece of old radio panel. Saw three pieces seven inches long and one half inch wide, file one half inch of the end of each to one quarter inch round and drill six holes one inch apart through each to thread the wire through.

On a seven-inch square hardwood or bakelite base, drill three one quarter inch holes inclined out at an angle of about 20 degrees, equidistant on a circle of six-inch diameter. Insert the bakelite posts. If about ten turns of wire are wound on a large bottle, the wire can be easily threaded on the form to make a coil of six turns, six inches diameter at the base and nine inches at the top.

Next obtain a cardboard tube about 20 inches long and about four inches diameter. The kind linoleum rugs are rolled on is ideal and any furniture store will give you one. This should be heated in an oven and basted with hot paraffine until thoroughly impregnated. On this tube, to within an inch of either end, wind closely one layer of Number 24 or 26 gage enameled wire.

Assemble your apparatus to conform to the circuit diagram, noting the fuses on the primary line. Use heavy wire or copper ribbon for wiring.

Place the high-frequency coils on porcelain insulators or glass jars. Use clips on the primary and adjust till maximum results are obtained. When this apparatus is in operation, be very careful to keep away from the high-tension and condenser wires, as the currents from these are dangerous, although the high-frequency currents



The author and his high-frequency coil, power transformer and glass-plate condenser. He holds in his hand a group of electric light bulbs, which may be lighted by the coil's discharge

can be drawn off to the body with a metal rod without shock.

High-frequency currents will burn, however, if taken on the bare skin, and any loose coils about the room, such as radio coils and the like, will, while the coil is in operation, be charged more or less; in fact, all metal objects in the room will be energized.

Contributed by Stanley Bentley.

Learning to Use Our Wings

(Continued from page 447)

is not a question so much of the size of the city, as its location with reference to air lines, and that no city can afford to handicap its future by not building an airport.

If immediate prospects do not justify the construction of a complete airport, at least every municipality can and should provide a small emergency field with the minimum of equipment, to serve as a haven for the aviator in distress, and capable of expansion at the proper time.

A New Profession

INNUMERABLE young men are at the present time seeking to enter the field of commercial aviation. They often have the impression that aviation is solely a matter of being able to fly. For those who wish to make commercial aviation a profession, much more than being able to fly is necessary. Thus Captain L. D. Seymour in a paper presented before the American Society of Mechanical Engineers enumerated the duties of an air transport engineer as embracing:

The selection of routes; the selection of aircraft; the preparation of terminal field equipment; the development of airways; the provision of airway aids to navigation; the determination of flying schedules; the establishment of material sources of supply; the keeping of performance records; the preparation of cost estimates and analyses.

Any one of these divisions involves much study and experience. For example: The selection of an air route is not simply a matter of drawing a straight line between the two terminal landing fields. The potential business between the two points must be considered. Then a study must be made of the intervening country, its contour and elevation. The location of highways, railroads, trolleys, electric power, and telegraph and telephone systems must be determined. A careful survey must be made of the weather conditions, including the prevailing winds likely to be encountered. Each of the other duties enumerated above involves a similar number of subdivisions.

It can be seen that air transport work involves in reality almost every branch of engineering—aeronautical, mechanical, civil, and electrical. At the same time, a young man who has the energy and ability to train himself thoroughly will find air transport engineering a pioneer profession of the greatest interest and promise.

Starting the Engine

TO start an airplane engine it is necessary to introduce the explosive mixture into the cylinder, to be able to ignite it before the engine has reached any appreciable speed of revolution, and to have enough power to turn it over before it is itself supplying energy.

Aircraft engines have horsepowers that far exceed those of the automobile engine, and the starting torques accordingly are far higher. Two elements enter into the magnitude of the starting torque: mechanical friction, particularly in cold weather when the lubricating oil may be nearly solid; and the power necessary to overcome the compression force which works against the piston as it approaches the top of the cylinder. It is estimated that this starting torque for a 400 horsepower Liberty engine

Names—and what they mean



Oriental Rugs

The priceless things in this world are those not made for a price—not made to sell but to keep. Priceless indeed are those objects of art and domestic use that have been made to satisfy the heart hunger of ancient races for beauty; to record an epoch in family, tribal or national life; to send a prayer to the God of a people; to excel in sheer artistry, design, workmanship and beauty; to relate thoughts that cannot be expressed in words; in short, to create something so fine that age will add to its luster and the appreciation of an advancing civilization will increase the desire to possess and cherish. Such are Oriental Rugs into which countless thousands of humble weavers from seven to seventy have tied with ever-enduring threads and strands the hopes, aspirations and prayers of all history. It is worthy of note that some names begin by being merely tags to identify a product and are soon forgotten. Other names, like Oriental Rugs, acquire, through years of superlative merit in the product itself, a personality, a definite measure of value that is quickly recognized. Such a name, for instance, is

Tycos

It is accepted as a standard of excellence and value in the invention, manufacture and employment of instruments for indicating, recording and controlling temperature in the home, the office, the factory, the hospital, and on the farm. In industry alone the name TYCOS symbolizes a Sixth Sense which makes possible the correct and efficient application of the five familiar senses—sight, hearing, smell, taste and touch. TYCOS on Temperature Instruments means the same as Oriental as applied to rugs.

For three-quarters of a century, in England and America, TYCOS Temperature Instruments have been made not so much to sell for a price as to render a service that would contribute to the advancement of health and happiness in the home and office, progress on the farm and accomplishment in science and industry. In the great TYCOS organizations of engineers, scientists, executives and artisans are men and women who have devoted their lives to this work, many of them following in the footsteps of their parents who in turn dedicated themselves to the perfection of devices for indicating, recording and controlling temperature; for forecasting the weather; for guiding the explorer and hunter through uncharted forests; for a thousand uses that touch humanity in some manner. So experienced are members of the TYCOS organization in meeting the needs of the past that it is able to meet new demands, that are the outgrowth of industrial and scientific development. It matters not what your problem is, so long as it pertains to temperature or weather, TYCOS engineers have the solution that is yours upon request.

Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING

Office Thermometers

An aid in promoting human efficiency.

Bath Thermometers

To enable you to get the most good from your bath.

Home Sets

Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Wall Thermometers

To help you maintain a temperature in your house conducive to good health.

Quality Compasses

To show you the right way in unfamiliar country.

Fever Thermometers

A necessity in every home.

Stormoguides

Forecast the weather twenty-four hours ahead with dependable accuracy.

Hygrometers

To enable you to keep the humidity of the atmosphere in your home correct at all times.

FOR THE MEDICAL PROFESSION

Sphygmomanometers, Pocket, Office and Recording types. Urinalysis Glassware. Fever Thermometers.

Taylor Instrument Companies

ROCHESTER, N. Y., U. S. A.

CANADIAN PLANT
TYCOS BUILDING
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MANUFACTURING DISTRIBUTORS
IN GREAT BRITAIN
SHORT & MASON, LTD., LONDON



Widening the Telephone Horizon

*An Advertisement of the
American Telephone and Telegraph Company*

IN THE memory of many now living, Alexander Graham Bell made the apparently rash prediction that the day would come when we could talk to other countries, even across wide expanses of water. That was shortly after the historic conversation between Boston and Cambridge, a distance of two miles.

Bell's vision was made a reality when in 1926 New York and London spoke together in two way conversation, and when in 1927 this service was opened to the public between any point in the U. S. A. and Great



Britain. Since then, Mexico has been brought into speaking distance; important cities of continental Europe have come within the voice horizon of the United States.

Even more important, the Bell System in the United States now embraces 18,500,000 telephones—a growth for the past year of more than 750,000.

We may now converse with each other from practically any point in this country to any other, and may talk beyond our borders and across the sea. That is measurable progress in widening America's telephone horizon.

often may be as high as 400 foot-pounds. Many interesting devices have been developed in the solution of this mechanical problem.

In the German Benz engines, special release cams are brought into play which keep the exhaust valves open during the



A specially designed electric starter which was used to "turn over" the 1200 horsepower engine in Lieut. Williams' Schneider Cup racer

first compression strokes, and thus practically halve the starting torque.

The automobile driver is familiar with engine priming which becomes necessary because the engine is not turning over fast enough for the velocity of the air in the intake manifolds to carry the rich mixture into the cylinders. Since the pilot cannot get out and prime his engine very well, special hand-primers are provided in the gasoline system, with leads to each of the cylinder priming cocks. When the weather is very cold, a number of attempts to start may have to be made and an excess of gasoline may be pumped into the cylinder at each attempt. The cylinder walls are then washed clear of lubricating oil, and there is danger of scoring the cylinder. To overcome this difficulty, more volatile fuels such as ether and hydrogen have been used for priming.

As regards the spark, there is no difficulty when a battery system is used. But with a magneto, the engine will not turn over fast enough at starting to give a hot spark. In such a case it is customary to supply a hand-operated starting magneto, geared to run at high speed and turned independently of the engine.

Hand starting is not only a real effort in view of the powerful starting torque (two or three men are generally employed for such work on an aviation field) but is decidedly dangerous. Many men have been killed when swinging the propeller, and it is quite evident that mechanical means will eventually supplant manual methods altogether.

The best way is to have a starter in the plane itself, although this adds weight and complication. But even where a starter is not incorporated in the plane, manual effort may be avoided. Portable starters have long been used by the Army Air Corps.

When Lieutenant "Al" Williams was

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trying out his proposed Schneider Cup racer equipped with a 1200 horsepower "X" engine, in which no starter was to be carried aloft, a specially powerful mechanism had to be designed. Four electric motors were placed on an upright frame immediately in front of the propeller. They are attached to the propeller shaft by means of gears. After the engine is started, the gears unmesh and the portable starter is pulled away from the plane. Storage batteries supply current to the electric motors.

In the plane itself there may be provided a hand-cranking mechanism, an electric starter, or an inertia starter in which energy is stored in a small fly wheel rotating at great velocity. Auxiliary gas starters have also been used, as well as compressed-air starters. Compressed-air starters have been hitherto regarded as too heavy and complicated. They may be one of two types: one in which the starter is a small compressed-air engine which by means of suitable gearing turns the engine over; the other in which the starter supplies the compression pressure to the engine cylinder without the engine itself being in operation.

The Heywood injection starter is a recent and particularly satisfactory example of the latter type. It consists of a small air compressor geared to the engine, a seamless steel tubular tank six inches in diameter and 27 inches long, and variety of release valves, valves to the cylinder, gages and so forth.

Pressure on the starter button releases air from the small storage tank to the compound distributor which rotates and is timed with the engine. A portion of the compressed air enters the cylinder, which is on its power, stroke and forces the piston downward, thus rotating the engine at about 500 revolutions per minute. Simultaneously a lesser amount of the compressed air released goes through a carbureting process. The properly proportioned mixture of gasoline and air is forced into the cylinder that is on its compression stroke. Adequate compression so created, together with the properly carbureted mixture, permits instant ignition when the compression stroke is completed or the piston is past top dead-center. The explosion then forces the piston down, accelerates the engine to full speed and now creates a strong enough vacuum in the intake manifold for continued normal carburetion. Thus the start is completed.

It is claimed that the Heywood starter will operate regardless of weather conditions, can be operated at a distance from the pilot's cockpit, can be worked on either battery or magneto ignition, and that if the button is pressed while the engine is in motion, nothing worse than momentary super-charging results.

"Conquering the Air"

THE book named above, written by Archibald Williams, is published by Thomas Nelson and Sons. It is an excellent general narrative of the conquest of the air by man, beginning with the first balloons of the Montgolfier brothers, giving an adequate account of the work of the early pioneers of aviation and gradually bringing the reader to such feats as the first flight around the world and the British expedition from Cairo to the Cape. It is illustrated with some interesting photographs, and is clear and readable, although entirely conventional.



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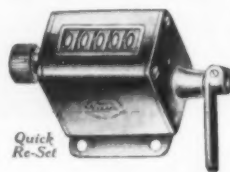
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Industries From Atoms

(Continued from page 452)

ing here should be to test the theory by experiment on some city of perhaps ten thousand people. It would be well worth while to drop tear gas, one that is obnoxious but not dangerous, on a civilian population which has been given about as much warning as they would get in warfare.

"Every citizen should have first been provided with a gas mask supplied by the War Department and he should have been educated in methods of quickly adjusting the mask and in a knowledge of the very great protection obtained in a house with closed windows and doors. It would be most interesting to see how quickly a population of ten thousand, for example, could protect itself from the tear gas. The protection might possibly be extended to horses, although this is less important. From such experiments on a large scale we might arrive at a thoroughly tested conclusion as to the real merits of gas warfare. In the meantime, the public bases its opinions upon prejudice and unreasoning fears."

Lacquer Solvents

ALCOHOL, designating but a single individual in prohibitionists' minds, is really the name of a very numerous chemical family, dozens of whose members are essentially useful in our growing lacquer industry, according to Bruce K. Brown, of the Commercial Solvents Corporation, addressing the Institute of Chemistry of the American Chemical Society recently. "American development of quick drying lacquers, now used in unbelievably huge quantities to replace oil and color varnishes, has forced the swift growth of industries supplying hitherto unknown solvents now necessary for lacquer manufacture," Mr. Brown said.

"In the past four years the new lacquer industry has been created. The manufacture of lacquers has created an expanding solvent market and has stimulated research in the production of solvent materials. As a result the number of organic solvents actually used in considerable quantities has probably been tripled since 1920. The lacquer industry has also had indirect effects on other solvent-consuming industries which have directly benefited by the cheapening of solvents for lacquer use.

"In no field of chemistry has there been greater recent progress than in the production and utilization of new alcohols. In 1919, so far as the speaker is aware, the purchaser of alcohols for industrial uses was limited in selection to three materials; namely, wood alcohol, ethyl alcohol, and amyl alcohol from fusel oil. Since that time startling progress has been made. Today there are literally dozens of members of this numerous family to be had in large quantities.

"In 1925 the Badische Company of Germany announced the production of methanol by the high-pressure catalytic reaction of hydrogen and carbon monoxides. This material immediately became available on the American market and during 1926 no less than 500,000 gallons of material were imported into this country. This influx has seriously embarrassed the wood distillers who had previously suffered quite an economic

blow from the large scale production of acetone by the fermentation process. Methanol prices dropped sharply and domestic production was greatly curtailed. It appears now, however, that the synthetic methanol importers will in turn be displaced by the production of synthetic methanol by two important manufacturers in the United States.

"Even in the ethyl alcohol field considerable progress has been made in the past few years. There has been a reduction in the cost of absolute alcohol, that is, ethyl or grain alcohol free from water, and a correspondingly widened use of this material as a solvent. Isopropyl alcohol, which until a few years ago was merely a laboratory chemical, is now available on a large scale for solvent use. This material is being manufactured in the United States as a by-product of oil-cracking operations and it is also produced in Europe.

"Secondary butyl alcohol is now produced on a considerable scale in this country from the waste gases in oil refineries. Within the past few months there has been an importation of isobutyl alcohol into this country. It is understood that this material is a by-product of high-pressure catalytic methanol synthesis. The manufacture of normal butyl alcohol from waste low-grade corn is now conducted on a tremendous scale.

"Amyl alcohol and amyl acetate are being made from natural gas. Normal and secondary hexyl alcohols are now available as by-products from other manufacturing operations. Ethylene glycol, made from natural gas, is an alcohol many of whose chemical derivatives are valuable solvents for the nitrocellulose used in lacquers.

"The alcohol family is almost as numerous as the Smith family and those mentioned above are only a few of its members especially important to the lacquer industry.

"In addition to the alcohols, many other chemical families, formerly mere museum curios, are contributing essentially to progress in this growing young industry."

New Sources of Cellulose

INCREASING use of cellulose for manufacture of artificial silk and related products is creating a demand which many inventors are seeking to meet from the refuse of various crops. Serious investigations of this subject of converting straw to valuable forms for use either in chemical manufacture or to replace wood pulp in paper have been prosecuted both in this country and abroad. Periodically, new methods are announced with the expectation that they may revolutionize the cellulose industry. The failures of such processes in the past have been so regular that any new proposals must be looked upon with scepticism. A recent announcement from France proposes a method of utilizing wheat straw in small plants located near farms and in this country there has been much talk of a process to use cornstalks as a raw material for pulp to be used for chemical manufacture. In speaking of the latter, *Industrial and Engineering Chemistry* says in a recent editorial:

"Scientists have long since ceased to be prophets, for they know that the impossible is achieved almost daily. So far as cellulose is concerned we shall make no prophecy,



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material that it flows directly from the phosphoric acid process into vats used in the first stage of plaster manufacture. From there on, with comparatively little handling, the waste is put through specially designed machines and comes out as a finished plaster block cut to standard size.

Cellulose Now Goes to the Movies

A PHOTOGRAPHIC emulsion, with cellulose replacing gelatine as a base, is reported in France by a recent Department of Commerce bulletin. Most commercial photographic films, plates and papers are coated with gelatine emulsions, that is, a suspension of silver halides in gelatine solution. Every amateur photographer knows that the developing and fixing baths must be kept cold, even iced on warm days, to prevent the softening and loosening of the gelatine coating. Gelatine of the utmost purity is required for the manufacture of sensitive emulsions, since even slight traces of impurities affect its photographic properties. The peculiar properties of gelatine have necessitated the development of many specially devised methods for such steps as washing and coating the emulsion.

The cellulose base emulsion is the invention of M. Philippe David who claims that his gelatinless plates can be developed in three or four minutes, printed in 10 minutes and that the emulsion is not affected by boiling water. The details of M. David's method have not been revealed, but one instinctively assigns it a relationship with viscose and "cellophane," the popular transparent wrapping paper.

While such an emulsion would seem to offer certain advantages over the gelatine type, the highly perfected state of the present art restricts the present importance of the new development to an academic interest.

Protecting Marine Piling

FROM a long series of experiments conducted in the harbor of San Francisco, W. D. Ramage and J. S. Burd of the University of California have reached some important conclusions regarding the protection of marine piling against the attack of borers. In reporting their observations in *Industrial and Engineering Chemistry*, they say in part:

"Certain oil-tar distillates have a greater protective value against marine borers than that with which they have ordinarily been credited. Inorganic substances, by themselves, have little prospect of value in the preservation of marine piling against borer attack. Chlorine treatment has no practical value in the protection of piling against marine borers."

Repellents for Blowflies

BLOWFLIES, by depositing their eggs in animal wounds, cause losses to livestock owners amounting to many millions of dollars annually. Methods for repelling them to prevent this loss have been studied by investigators of the Department of Agriculture at Washington. They studied the effect of various repellents when placed upon pieces of fresh meat and in stating their results in *Industrial and Engineering Chemistry* conclude:

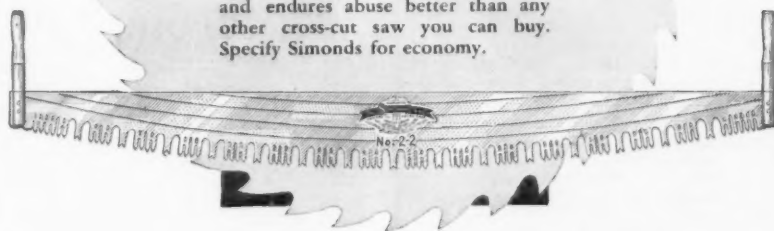
"The most effective blowfly repellents are not necessarily highly odorous materials, such as essential oils, or even highly irritating materials, such as chloropicrin and

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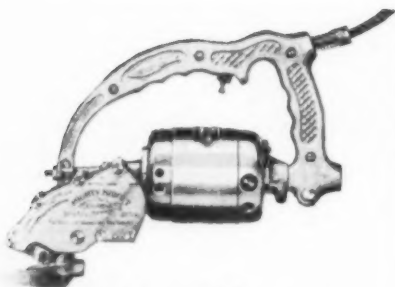
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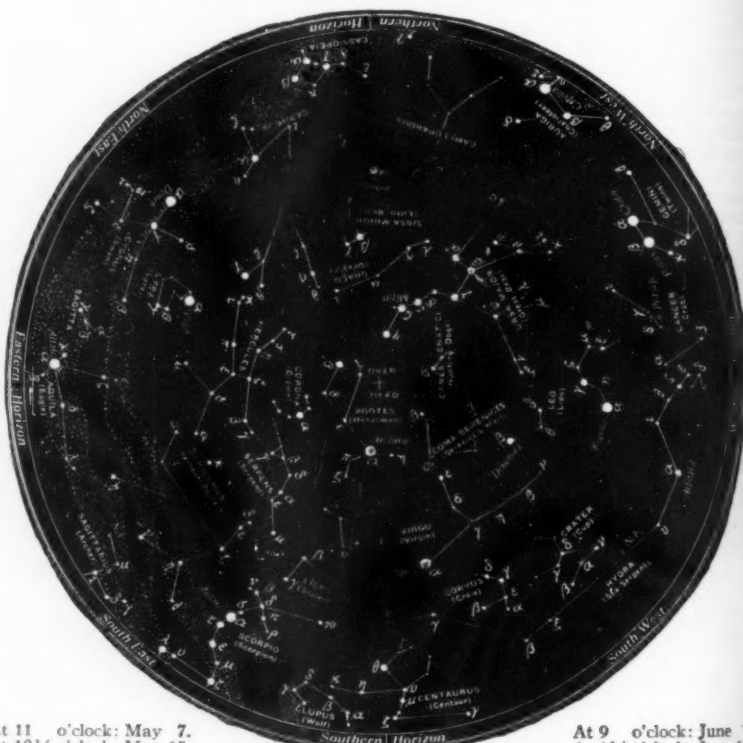
other "tear gases," but are materials which can absorb, or inhibit the formation of the volatile compounds evolved by decomposing meat which attract the flies to the meat. In addition to various copper compounds, such strong antiseptics as mercuric chloride, potassium permanganate, sodium salicylate, et cetera, when applied

to meat render it almost entirely non-attractive to blowflies.

"Tests are now being conducted to determine the practicability as blowfly repellents of copper carbonate and certain other powders when applied upon the wounds of animals under outdoor conditions."

The Heavens in May

By **PROF. HENRY NORRIS RUSSELL, Ph.D.**



At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.

At 9½ o'clock: May 30.

At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

The Heavens

THE winter constellations are gone now, all but Gemini which is setting. Leo is in the west and Virgo and Hydra in the southwest. Scorpio east of south, Ophiuchus in the southeast. Aquila in the east, Cygnus and Lyra in the north-east and Hercules higher up. Boötes is south of the zenith and Ursa Major north of it. Next below are Ursa Minor and Draco, and Cassiopeia is low in the north.

The Planets

Mercury is in conjunction with the Sun on the 3rd, actually passing behind the Sun's disk. After this he is an evening star, and by the end of the month he should be conspicuous. He is in Gemini and unusually far north, so that he remains visible till 9 P.M.

Venus is a morning star and is drawing close to the Sun. She rises about 4:20 A.M. in the middle of the month.

Mars is a morning star, too, rising between 2 and 3 A.M.

Jupiter is about 25 degrees farther east in the heavens and rises an hour and a half later.

Saturn is approaching opposition and

can be observed through most of the night.

Uranus is a morning star in Pisces. He is in conjunction with Mars on the 25th, being not quite one degree north of the brighter planet.

Neptune is in quadrature west of the Sun on the 17th, and is observable in the early evening.

The Moon is full at 3 P.M., May 4th; in her last quarter at 4 P.M. on the 12th; new at 8 A.M. on the 19th; and in her first quarter at 4 A.M. on the 26th. She is nearest the earth on the 19th; and farthest away on the 5th. She is in conjunction with Saturn on the 7th, Mars and Uranus on the 15th, Jupiter on the 17th, Venus on the 18th, Mercury on the 20th, and Neptune on the 25th.

On May 19, there is a total solar eclipse of a very curious character. The central line of the Moon's shadow just misses touching the Sun, but as it skims through space a few miles above the Antarctic Ocean south of Africa, the outer part of the shadow strikes the earth's surface. But it is improbable that any human eyes will see the phenomenon. As a partial eclipse the affair is visible over a great part of the South Atlantic, and in South Africa.



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The Scientific American Digest

(Continued from page 445)

in this product which was described in the SCIENTIFIC AMERICAN Digest in the issue of December, 1926. At that time it had just been introduced from Europe where it had been used for a number of years.

The type of triplex used in windshields and windows of automobiles is identical in appearance with ordinary plate glass and consists of three layers. The two outside layers are of the finest obtainable plate or sheet glass, according to specifications, and the middle layer a binding composition commercially known as pyroxalin plastic. This is a perfectly transparent sheet of cellulose material, like celluloid, which may, in fact, also be used.

Two pieces of glass and one piece of pyroxalene plastic are cut to the exact size and shape of the desired windshield or window. This must be done with infinite care as after it is finished triplex can not be cut or altered in size. These three layers are then laid together and put through 17 different processes, including chemical cleaning, pressing between huge presses, which exert many tons pressure on each piece of glass, heating, grinding, polishing, and sealing. The sealing compound is applied to the outside of the juncture of the three laminations. It keeps out weather, moisture, vibration, and all other influences which, if they could get in between the layers, would in time eliminate the very safety features which are essential.

Under ordinary impact triplex will not shatter or create flying fragments because the flexible center layer holds tightly to the outside layers. Under very severe impact, it is important to note, triplex will yield and let a flying body pass through it.

Cadmium Finds Use in Solders

CADMIUM, chemical brother to zinc, is finding a useful place in industry as one of the components of special solders, Carl E. Swartz, metallurgist of Selby, California, told the American Institute of Mining and Metallurgical Engineers at a recent meeting.

Lead, tin, and zinc are the metals used in such common solders as those for sealing tin cans, but where lithographed labels are used on tin cans a special solder containing cadmium is now used because its lower melting point prevents discoloration of the lithographing.—*Science Service.*

Mexican Fiber Better Than Kapok

Kapok, the light, buoyant fiber now imported from the East Indies by the thousands of tons for use in life preservers and mattresses and for many other purposes, may soon have to meet with serious competition from an even lighter and more waterproof fiber grown under the American flag.

Pochote is the name of the new fiber. It is the product of a Mexican tree, and has long been harvested from wild specimens by the Indians and used in a small way. But the possibilities of the long silky hairs that pack its seed pods have now been recognized by the United States Department of Agriculture, and according to Lyster H. Dewey, fiber specialist, experimental plantings on a large scale are now being made in Porto Rico.

In an experiment performed in the Department of Agriculture laboratories, a

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pochoate float was loaded with fifteen times its own weight in lead, and left in a vessel of water 189 days without showing any signs of sinking. A similar load sank a kapok float in 25 days.

The fibers, of which four or five pounds can be harvested from a tree, are stiffer and smoother than those of cotton, so they can not be woven into cloth or matted into felt. Instead, they spring apart, forming an exceedingly light, fluffy mass. It is this quality that makes them valuable for cushions and mattresses. It also makes them exceedingly useful for packing the walls of refrigerators and for other heat-insulating purposes, and it is partly at the instance of manufacturers interested in heat-insulation that the experimental plantations are being set out in Porto Rico.—Science Service.

Gasoline Motor Pavement Breaker

THE Milwaukee Gas Tool Corporation has developed and perfected a new labor-saving pavement breaker that is radically different from others now widely used. This machine has been tried and



Complete equipment of the one-cylinder pavement breaker

proven for the past two years a number of them having been used on all sorts of jobs under severe working conditions.

It is in reality a one-cylinder gasoline motor which has no fly wheel, connecting rods, camshaft, or bearings. The piston itself acts as the hammer, striking more than 1000 terrific blows a minute. These blows are transmitted through an anvil directly to any standard cutting tool that may be used.

The entire unit is self-contained and requires no outside equipment of any kind. It weighs only 85 pounds and is said to operate all day on two gallons of gasoline.

35 Sons, No Daughters

A FAMILY in which the male tendency is so strong that for four generations not a daughter has been born has been discovered in San Pedro, California, through records reported to the Eugenics Records Office.

No daughters have been born in the four generations although there have been 35 (Continued on page 474)



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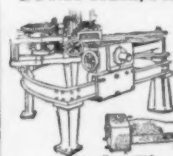
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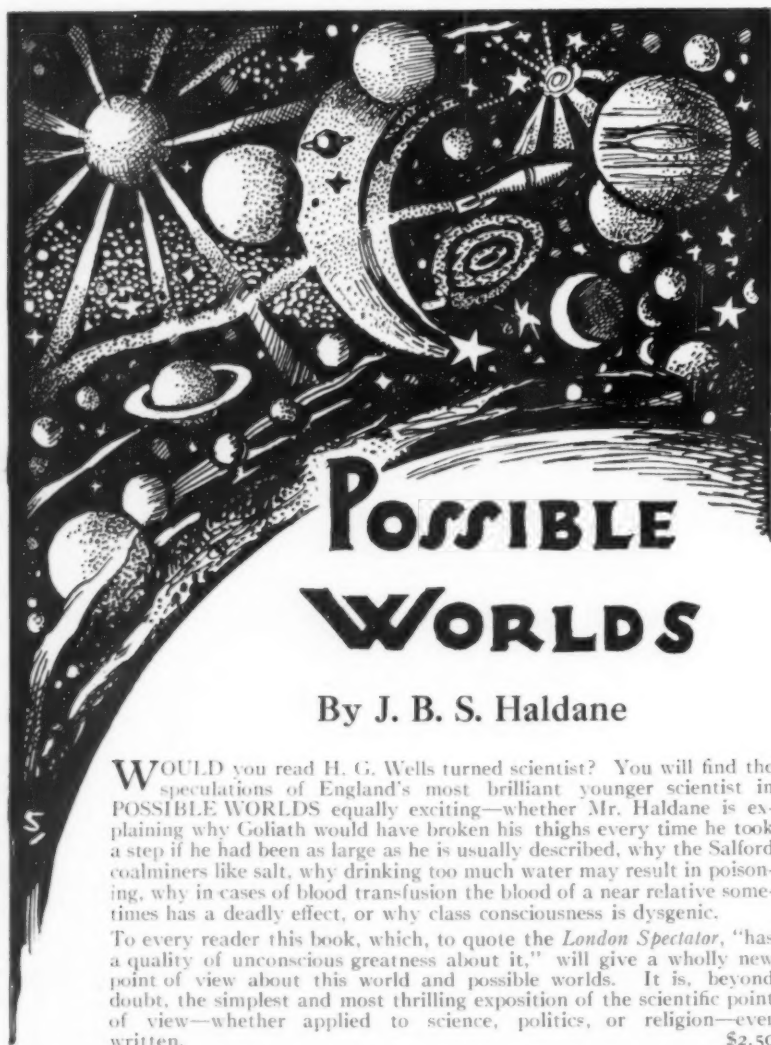
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The Scientific American Digest

(Continued from page 471)

sons. The founder of the American branch of this family was born in Germany, the youngest of 19 boys. He, in turn, had twelve sons. Out of these, one married an English Canadian woman. They had one son, who married and had three sons.

Chance as the sole explanation of this continued production of male children only is considered to be highly improbable. One hypothesis advanced is that the female embryos are early destroyed by some hereditary lethal factor carried by the family from generation to generation. Dr. C. B. Davenport, director of the Eugenics Records Office, Cold Spring Harbor, New York, is making a study of such one-sex families in an effort to determine their cause. He would welcome reports of other families.—*Science Service.*

Pneumatic Tubes Transport Steel Samples

RED hot samples of steel are shot through pneumatic tubes recently installed between a German steel mill and its testing laboratory. This novel method of conveyance is employed in order to allow the laboratory to be located away from the smoke and dirt of the mill itself.—*Science Service.*

Mirror Traffic Warning for Private Drive-way

A MIRROR placed at the exit of the driveway, to reflect passing traffic, constitutes a simple and very practical device for giving greater safety to the car when being driven from one's private



A mirror, placed at one's driveway, warns of approaching automobiles

grounds into a heavily traveled and perhaps tree-lined street. The accompanying illustration shows a private driveway exit so equipped. The mirror, about eight by 14 inches in size, is supported by a special wrought-iron standard, painted black, and its top is approximately five feet high. It is placed beside the exit just inside the street curbing, and is so turned that street traffic approaching from the left is clearly mirrored to the driver who is about to leave the private drive-way, at a point far enough back that he may easily stop his car if another is dangerously near.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

British Patents in The United States Navy

THE United States' Navy is now operating under an agreement, to run 10 years, during which the navy will pay to the Handley-Page Company, British aircraft manufacturers, the sum of 875,000 dollars for the use of its patents. At the end of the term the United States will have unlimited use of the patents without payment of royalties.

During the World War the Navy entered into a contract to use the British company's patents. Later the Navy paid the company 125,000 dollars but the validity of the patents was questioned by our government and through our Department of Justice brought suit in the British Courts for the recovery of the money. The present agreement, reached recently, is a compromise, and the 125,000 dollars will apply on royalties to be paid on future patents of the British company which our navy may use.

Pianos and Radios

IS a radio set an electrical device or is it a musical instrument? That depends upon whether you are speaking scientifically or commercially.

When the Premier Radio Corporation sought recently to register the trademark "Premieradio Grand" for radio receiving sets, objection was successfully raised by the Premier Grand Piano Corporation, on the ground the piano company had used and registered the mark for pianos and piano players prior to the date that the radio corporation used it on radio sets. The ground for the decision is that the making and selling of radio receiving sets is but the logical extension of the business of a piano manufacturer and that, therefore, such manufacturer is entitled to extend his registration to the later class of goods.

"Confusion of origin of goods would seem to be quite certain," says First Assistant Commissioner Kinnan in declaring for the piano corporation, "if the same mark appeared upon a combined piano and radio receiving set as appeared upon a separate radio receiving set."

Edison's New Work

RUBBER is second only to raw silk among raw materials for which the United States must depend upon foreign sources. For the men who can produce a satisfactory rubber or rubber substitute from native sources, there are unlimited possibilities and for years inventors have been attacking the problem. Now Thomas A. Edison is trying his hand, and he is going about it systematically.

With his experts from his East Orange laboratory he has visited the Departments of Commerce and Agriculture to obtain all the data available on rubber plants in all parts of the world. The Department of Commerce has instructed its agents in foreign fields to gather material and data.

So far, Mr. Edison has experimented largely with cryptostegia, a rubber extracted from a plant grown in Madagascar; it is one of the two rubber producing plants which can be harvested with machines. It is the inventor's hope to work on every likely kind of plant in the hope of developing one which can be transplanted and cultivated in the United States on a large commercial scale.

Government departments and business men are watching the experiments of our best known inventor with keen interest. Success will mean a revolution in the rubber industry.

Unused Patents Will Be Strictly Construed

WHAT is there to prevent a rich corporation from acquiring a patent, either pending or issued, and doing nothing with it but merely holding it to keep anyone else from using it? There is nothing in the law of this country which makes such a practice impossible. That the courts frown upon it, however, and do all they can to minimize the advantages of the offending corporation, would seem to be indicated by a recent decision of Judge Tuttle in the United States Court for the eastern district of Michigan.

The case was a suit in equity brought by the Toledo Scale Company charging the Barnes Scale Company with infringing claims of the Hem patent for counter scales for use in stores. The judge finds:

"The evidence shows that the plaintiff, Toledo Scale Company, is one of the largest manufacturers of scales in the country. Notwithstanding this invention has been in their possession for nearly nine years, they have never marketed this type of scale, and it appears they have built only one model of this scale and that for this lawsuit. Plaintiff insists that the patent has been issued less than two years and that consequently no unfavorable results should follow its non-use during that period.

"However, here is a large company fully able to commercialize the invention, if it be a valuable one, and, under these circumstances, I feel that the fact of its non-use should date from the date of the application rather than the date of issue of the patent. This non-use having existed for approximately nine years, I think it is fair to regard the Hem patent in suit as a paper patent. While non-use does not disentitle the plaintiff to recover where it is clear that his patent is valid and that the defendant has infringed, on the other hand such non-use requires that the patent be strictly construed and that the patentee be given nothing but that to which he is clearly entitled."

Of the defendant's scale he says:

"The evidence shows that it was designed and put on the market in 1919 or 1920 by the Barnes Scale Company, with no knowledge whatever of the Hem invention, and in perfect good faith. A great many of these scales have been built and successfully

marketed by the defendant, which knew nothing of the Hem invention until the issue of the Hem patent in 1925."

The judge finds the claims in the Toledo Company's patent void and dismisses with costs the complaint brought by the company.

Patents on the Ogee Curve

THE "ogee" curve is the line known to art and architecture as the "line of beauty." It consists of a double or reverse curve, convex and concave. This curve is used in the bottle in which Coco-Cola is sold. The bottle is protected by a design patent. Recently the Coca-Cola Company sued the Whistle Company of America for infringement, claiming that the ogee curve appears also in the Whistle bottle, and that a design patent must be given a construction that will make it of value in the useful arts and a scope that will bar the use by others of not only an identical design, but of all other designs so similar as to deceive ordinary observers. The Whistle Company, on the other hand, maintained that the doctrine of equivalents is not applicable to design patents.

"It may be assumed, without deciding, that it is infringement to imitate the characteristic feature of the patented article or design even though there are other differences; that side by side comparison in court is not a proper test," rules Judge Morris in the Delaware Federal District Court.

"Whether the heart of the invention resides in the employment of the ogee curve must be ascertained from the novelty of the curve and its employment in the prior art. There is, of course, no contention that the curve itself is novel, for it is as old as the human body. By means of it the pottery of the most ancient races was made pleasing to the eye. For centuries it has been the handmaid of the architect. It has, as well, been long employed in designs for bottles.

"Save for such similarity as results from the common use of the ogee curve and the resulting curvilinear construction of the bottle, the most casual observer would find no difficulty in distinguishing one bottle from the other.

"As these general characteristics are not within the monopoly of plaintiff's patent, and as confusion, if any, to constitute infringement, must result from similarity of the patented design, I see no escape from a finding of non-infringement."

Ford Ordered to Pay Royalties

THERE is no power on earth, this side of the Supreme Court of the United States, which would make Henry Ford sign a license agreement or pay a royalty."

This statement has been made by Mr. Davis, Ford's patent attorney stationed at the plant. Because of this attitude, exactly 98,000 dollars has been added to the judgment awarded the Parker Rust Proof

Company, winner of the latest patent suit against the Ford Motor Company in the Federal Court for the eastern district of Michigan, southern division.

The infringement action was based on Patent Number 870,937 issued November 12, 1907, to J. W. Coslett for improvements relating to the treatment of iron or steel for preventing rusting. Claims of the patent were found valid and infringed by the Ravenizing process used by the Ford Company. The recent decision, with Judge Tuttle writing the opinion, is by way of reviewing the master's report on the subject of damages and profits.

The Parker Company derives its income from license fees paid by others for the right to use its patented rust proof process, from the profits it makes on the materials used by its licensees, and from the profits made in its jobbing plant rust-proofing articles of iron and steel for others. Where the licensee used its process in large quantities, the usual royalty was twelve and a half cents per year per gallon capacity of the processing tanks used. Licensees were obligated to purchase the materials used from the Parker Company.

After approving of the master's report of reasonable royalties from September 9, 1920, to November 24, 1924, together with 5 percent interest, making a total of \$269,174.36, Judge Tuttle says:

"During the infringement trial which occupied about 40 court days, the character of the defense was such that plaintiff was put to unusual expense to meet it. Defendant's experts repeatedly presented alleged and unforeseen results of extended experiments and claimed to deduce therefrom either that the Ravenizing of its products did not constitute infringement of the Coslett patent or that the Coslett process was inoperable. It was then necessary for plaintiff's experts to check defendant's experiments and in each case, plaintiff showed that Ravenizing was the process of the Coslett patent and that the Coslett process was operable exactly as described in the specification of the patent in suit no matter how such specification might be construed.

"The defendant corporation, being one of the largest in existence, is doubtless made defendant in much unjustifiable litigation, and it may be good policy for defendant to make such litigation so expensive for its opponents that many intending contenders are deterred from bringing suits. There seems to be no doubt but that defendant spent upwards of 200,000 dollars in the defense of this suit. The record shows, too, that Mr. Henry Ford, who dominates the defendant corporation, is absolutely opposed to the operation of the present patent system and to the payment of royalties to any one. This is clearly expressed by a statement made by Mr. Davis, defendant's patent attorney stationed at the plant.

"There is no power on earth, this side of the Supreme Court of the United States, which would make Henry Ford sign a license agreement or pay a royalty."

"With these ideas in mind, counsel for defendant were quite successful in causing plaintiff to expend large sums (\$49,933.07) during the infringement trial, according to data furnished the master and substantially the same sum during the accounting, according to undisputed statements in open court. Plaintiff is a comparatively small corporation and this expense was an enormous strain on its resources. As a large portion of this expense was unnecessarily

forced upon plaintiff, 98,000 dollars should be added to the \$224,588.39 determined as reasonable royalty and \$44,585.97 as interest, making a total of \$367,174.36, to which interest at 5 percent from the date of the master's report should be added. Plaintiff will also recover the usual taxable costs in this case including those of the accounting."

The Trademark Revision Bill

PENDING in Congress is a bill introduced by Representative Albert H. Vestal, of Indiana, which many authorities on patent and trademark procedure believe will have a distinctly harmful effect on business. Believing that the radical innovations in trademark law which the Vestal bill proposes should be defeated, a committee of the Boston Patent Law Association makes a criticism which the SCIENTIFIC AMERICAN approves and prints in full herewith:

"We do not approve of the provision contained in Section 2 (f) whereby it is provided, in effect, that a descriptive mark, a mark having geographical meaning, or a mark consisting of a surname, may be registered as a trademark. Such words are not trademarks. They are protected by the courts on grounds of unfair competition when it is shown that they have acquired a secondary meaning denoting a particular manufacturer, in such cases the burden of establishing the secondary meaning being

upon the plaintiff. Under the proposed law, a person using such a descriptive term can register it by an *ex parte* showing in the Patent Office and the fact of such registration gives him a *prima facie* case in court. We think this is unjust and that the law should be allowed to stand as it is in regard to this class of marks.

"We do not approve of the provisions of Section 3 (b) of the bill. Under this provision it would be possible for a person to register, as a trademark, a purely descriptive or geographical term such as the word 'St. Louis' for shoes, or even the word 'Woolen' for cloth, and to do this without having used the word for a single day prior to his application for registration; provided only that he makes oath that no one else 'has any superior right' to the use of such mark. Upon the basis of such registration he can then get a certificate of registration which will be a basis for his obtaining registrations in foreign countries, which will presumably exclude his American competitors from exporting goods under those names to those foreign countries, although they have just as good a right as he to the use of the names.

"The present Act of 1920 provides that a man may register a non-technical or descriptive mark which he has bona fide used for one year in this country and upon the basis of such registration he may obtain foreign registrations. It seems to us that this is all that any manufacturer should be allowed to ask. If he has no American

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT LANDING GEAR—Which consists of endless tractor elements adapted to contact with the ground and ride over the uneven surfaces, reducing shock and jar to a minimum. Patent 1658700. A. A. Anderson, 80 W. 40th St., New York, N. Y.

FLYING MACHINE—In which the operating principle of a bird's wing is adapted mechanically to enable the support and flight of the machine. Patent 1657669. G. Ferguson, Executrix Mrs. G. Ferguson, 125 East Ave 32, Los Angeles, Calif.

HELICOPTER—Having means to produce air pressure beneath a plane in a manner to cause the helicopter to rise, and will function to cause forward movement. Patent 1660257. E. L. Crespo, c/o Julio Aparicio, 60 Haven Ave., New York, N. Y.

DIRIGIBLE HELICOPTER—For use on airplanes with perfect safety. Patent 1658290. Y. H. Koun, 693 W. 115th St., New York, N. Y.

Pertaining to Apparel

UNDERGARMENT—For men, rendered especially comfortable by virtue of the manner in which it is cut and assembled to afford ample crotch and seat room. Patent 1661072. C. W. Hutchinson, 15 East 40th St., New York, N. Y.

Designs

DESIGN FOR A CURTAIN—Pole End. Patent

74359. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York.

DESIGN FOR A CURTAIN—Pole Ring. Patent 74357. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A CURTAIN—Pole Center—Patent 74358. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A LOUD-SPEAKER RESONATOR OR THE LIKE—Patent 74364. P. H. Fuller, Lefingy Ave., Dobbs Ferry, N. Y.

DESIGN FOR LACE—The inventor has been granted patents on two ornamental designs for lace. Patents 74343 and 74344. B. A. Ball, c/o American Textile Co., Pawtucket, R. I.

DESIGN FOR A DRAFT ARM FOR SODA FOUNTAINS—Patent 74419. T. de Stefani, 10804 Prospect Ave., Chicago, Ill.

DESIGN FOR A DRESS—Patent 74478. Katherine E. Burns, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A CURTAIN—POLE END OR SIMILAR ARTICLE—The inventor has been granted two patents for ornamental designs. Patents 74552 and 74553. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A RADIATOR ORNAMENT OR THE LIKE—Patent 74565. J. Guerr. J. Guerr and N. Masone, 179 Front St., Brooklyn, N. Y.

rights superior to those of his competitors, he should have no certificate which gives him a basis for obtaining foreign rights which can be used against his American competitors. The argument that a man desiring to export his goods may be inconvenienced by having to wait a year before registering the mark does not appeal to us. Let him choose a proper trademark, some term that is not common property, and he can register it without waiting a year. If he elects to adopt a descriptive or geographical term, he ought not to be given any foreign rights in that term until he has acquired some vestige, at least, of American rights by usage. We should not object to a provision whereby an applicant for registration might have his application given precedence upon a showing that he wishes to use the mark immediately in foreign trade.

"Moreover, while the registration provided for under this clause of the bill does not give the registrant any rights in the United States, it does authorize him to mark even the goods which he sells in the United States 'Registered United States Patent Office,' thus deceiving competitors not familiar with the trademark laws into the belief that he has a valid United States registration.

"We do not approve of the provision for the 'entry' or deposit of marks as provided in Section 5 of the bill, at least in its present form. If this provision of the bill has its intended effect, there will be a flood of marks deposited. These will include marks having only ephemeral, and perhaps no real value, and such marks, although never perhaps used to any material extent, will stand forever on the books as an impediment to subsequent adoption of the marks by others. It is already difficult to find marks which have not previously been preempted by other actual registrants. The deposit plan, if it has its intended effect, is likely to make this well-nigh impossible. If there is to be a deposit plan, we think there should at least be coupled with it some provision whereby the 'dead wood' may be weeded out periodically so that the collection of 'entered' marks shall include only marks which are in actual use and not abandoned. A registration under the present law lasts for only 20 years unless renewed. We suggest that it might be provided that a deposited mark should be removed from the files unless at the expiration of some fixed period (say five or 10 years) the depositor files an affidavit that the mark has not been abandoned and that he is continuing to use it, such affidavit to be made on a form mailed to the depositor by the Patent Office, say three months before the expiration of the five year period.

"We oppose the scheme of limited territorial registrations provided for in Section 12 of the bill. This, as we read it, would allow, for example, a person residing in New York who is familiar with the fact that a certain mark has been used in a business on the Pacific Coast which has not extended beyond the coast states, to apply for, and obtain, registration for the rest of the country, thus barring the legitimate development of the business of the first user of the mark on the goods and giving the New York man, the second user, the presumptive right to use the mark exclusively throughout all the rest of the country, although he might himself only have used it in trade between New York and New Jersey and that for a very brief

Chemical Processes

INK REMOVER—Consisting of benzol, alcohol, sodium chloride and fusel oil, in liquid form for the removal of ink from plates, rolls, type or other surfaces. Patent 1658739. H. F. Porter, 1222 Evergreen Ave., Bronx, N. Y.

Electrical Devices

CABLE TERMINAL FOR STORAGE BATTERIES—Which is proof against corrosion, and easily attached to or removed from the battery post by an unexperienced person, and without the use of tools. Patent 1658752. W. F. Wilford, Fort Benton, Montana.

ELECTRICAL STEAM GENERATOR—A portable steam generator, furnishing steam quickly for the opening of storage batteries or other purposes where steam is desired in a short period. Patent 1659513. C. B. Baughn, 456 Main St., Visalia, Calif.

VARIABLE RESISTANCE—Which is adjustable and adapted to be connected between the aerial and antenna post of a radio set, whereby static and other disturbing frequencies may be eliminated. Patent 1660251. W. L. Burnam, Harrisonville, Mo.

CONTROL DEVICE FOR RADIO SETS—A simple construction whereby the operation of a plurality of apparatus in a radio set can be easily effected by a single manually operated element. Patent 1660278. E. P. Schwarze, Jr., 730 Crescent St., Astoria, N. Y.

TERMINAL-TESTING UNIT FOR SPARK PLUGS—Which will preclude any shock to the person conducting the test, and eliminate the necessity of using tools or other instruments for the purpose. Patent 1650546. H. J. Strahan, with Wm. Chapman, c/o Simons Steward & Foy, 1750 Grand Concourse, New York, N. Y.

ELECTRIC FURNACE—Such as are used in dentistry, for a direct application of heat in carrying out fusing operations on a comparatively low voltage. Patent 1661026. A. J. Asch, c/o Wm. Kaufman, 1482 Broadway, New York, N. Y.

TERMINAL CLIP—A spring-metal device, whereby an electrical conductor may be easily gripped and removed with equal facility, yet reliably held for good electrical contact. Patent 1661124. H. M. Koretzky, c/o Bright Star Battery Co., 15th St. & Riverhead, Hoboken, N. J.

DEVICE FOR AMPLIFYING VOLTAGE AND CURRENT—By means of which a very high degree of distortionless voltage and current amplification may be obtained by utilizing given voltage to deflect a retarded cathode ray for the subsequent reproduction of Leonard rays. Patent 1659636. F. E. Null, 46 Fairview Ave., Bound Brook, N. J.

Of Interest to Farmers

BROODER—Which maintains the correct temperature over a relatively great area, producing gradually an increased temperature at the outer edge thereby sheltering the chicks from cold air. Patent 1658690. W. C. Sanctuary and W. A. Jones, 11 Cottage St., Amherst, Mass.

PLOW SUPPORT—Especially adapted for use with disc plows, whereby it is possible to plow close up to trees or fences without injury to the plow or its vehicle. Patent 1659142. L. C. Hester, Box 255, Williston, Fla.

MOWING MACHINE—Wherein a plurality of cutter bars are designed in such manner as to

period. Moreover, we see great difficulties as regards foreign registration if any such plan is adopted. Suppose two certificates of registration for the same mark are issued for different territories in the United States to different persons. Each may obtain a certificate of registration from the Commissioner and each may, on the basis of that certificate, seek foreign registration. Which of the two shall receive the foreign registration? Great confusion and uncertainty would result in foreign countries in which two or more such certificates were presented, with resulting uncertainty and probably injustice.

"We see serious difficulty in the provisions of Section 14 regarding transfer of a contested proceeding in the Patent Office to a court. It is provided in this section that either party may remove to the Federal Court, sitting in the district where the opposing party resides. Suppose both parties undertake to remove. Which court has jurisdiction? Moreover, the proceeding upon its transfer to the court may become an action for injunction or damages. It seems to us that the existing law gives an adequate remedy for any holder of a United States trademark registration and that anything that invites further litigation, as this proceeding does, is of doubtful value and might well lead trademark owners to hesitate before applying for United States trademark registrations, since they would know that such an application might set in motion a litigation leading immediately and directly to actions for damages. The only amendment to existing laws in this regard which seems to us desirable is a provision that the record in any contested proceeding in the Patent Office may be used as evidence in any subsequent proceeding between the same parties regarding the same mark, in a Federal Court.

"We see no reason for providing, as is provided in Section 21, that in a trademark case the court may allow attorneys' fees as part of the costs. No such provision obtains as to any other class of litigation, with the single exception of copyright litigation, and we see no reason whatever for making an exception to the general rule in the case of trademark litigation.

"As we read Section 22 of the bill, it would allow proceedings regarding registered trademarks to be brought in any District Court 'without regard to the citizenship of the parties.' A man living in New York, for example, might sue, in Texas or in Massachusetts, a man living in California. If this is not the meaning of the clause referred to, the language should certainly be clarified.

"We do not approve of Section 24 of the bill. We do not think that any registration should be granted by the Patent Office of any names which are not actually used as trademarks. The meaning of this clause seems to us very uncertain and bound to result in waste of effort in the Patent Office and subsequent litigation in the courts. We consider that the existing law provides all the remedy that should be given in the case of names or marks which are not used as trademarks.

"In the foregoing we have not undertaken an accurate or complete analysis of all the defects in the bill. We suggest that the matters to which we have called attention above are serious defects and so serious that the bill ought not to pass unless it is amended very radically along the lines above suggested and possibly along other lines also."

cut far more grain, and in less time, than is usual. Patent 1659511. W. W. Barker, Kones City Okla.

CORN PLANTER—Constructed for planting corn in check rows in such manner that the "thinning" of each "hill" may be accomplished during the first plowing. Patent 1661120. J. B. Hickam, R. F. D. No. 8, Columbia, Mo.

Of General Interest

COMBINATION LADDER STEP AND SUPPORT—Easily positioned wherever desired to form an extended step, for supporting a paint bucket, or holding the ladder top a short distance from the house. Patent 1658753. J. Wirth, 241 E. 79th St., New York, N. Y.

SAFETY TREAD—For steps and the like, constructed of anti-slipping material to fit any stair tread, for preventing slipping on the surface or the outer edge. Patent 1658756. F. A. Bandholtz, 636 Eastern Parkway, Brooklyn, N. Y.

SHINGLE—Formed with a special locking edge for preventing the shingles from curling or being bent outwardly from their normal relation with each other. Patent 1658685. J. A. McCarthy, 422 No. 7th St., St. Joseph, Mo.

PLATFORM SUPPORT FOR SUSPENDED SCAFFOLDS—Easily dismantled but when in use, capable of being supported by cables of any kind, or supports now commonly in use. Patent 1658670. T. Corbett, 501 Tiffany St., Bronx, N. Y.

THEATER CHAIR—Constructed with means which allow forward and rearward movement, so that persons leaving may do so without causing inconvenience to persons already seated. Patent 1659484. B. J. Fagan, c/o Knickerbocker Theater, 1396 Broadway, New York, N. Y.

POWDER-PUFF FOLDER AND LOOSE-POWDER CONTAINER—Of the general envelope type, one of the walls serving as a powder container, and the powder puff being carried in the main pocket. Patent 1659485. L. Friedberg, 969 Carroll St., Brooklyn, N. Y.

BEDCLOTHES HOLDER—Designed for use on children's or invalids' beds, to firmly hold the clothes intact at the foot of the bed, and simplify the bed making. Patent 1659519. C. N. Dilatush, 1792 No. Parkway, Memphis, Tenn.

MOP WRINGER—Comparatively small and light, yet braced to properly withstand squeezing action when a mop is wrung, the water removed falling by gravity into the bucket. Patent 1659505. W. H. Welch and F. H. Werschm, 10 Kampenga Ave., Muskegon, Mich.

PERFORATED SIGN—So constructed as to render it useless as a metal roof covering or shingle, but permitting its full use as a sign-carrying medium. Patent 1658883. C. R. Cole, 919 Orr St., Miles City, Montana.

COMBINATION SHIPPING CASE AND BELT REEL—Which permits the convenient and economical handling of large rolls of belting, serving as a shipping crate, a support and rotatable guide for the material. Patent 1659115. D. R. McKay, 400 No. Lincoln St., c/o Imperial Belting Co., Chicago, Ill.

WINDOW SCREEN—Adjustable to fit various sizes of windows, the screen sections engaging each other to prevent the passage of flies or other insects. Patent 1660227. S. & J. Levine, 499 E. 94th St., Brooklyn, N. Y.

COMPOSITE CHARACTER—Composed of a small number of geometrical characters capable of being associated in innumerable combinations to form letters of the alphabet and numerals. Patent 1660254. J. F. Carroll, c/o The Stevens, Chicago, Ill.

HATCHERY FOR MARINE LIFE—Particularly oysters and other shell fish, wherein means are provided within a limited area for substantially ideal conditions, for the spawn and young life. Patent 1660259. F. H. Elsworth, 95 Fulton Market, New York, N. Y.

PERPETUAL CALENDAR—Designed for desks and the like, to indicate the months and days of successive years, is ornamental in appearance and readily operated. Patent 1660232. E. Oldenbusch, 366 Butler St., Brooklyn, N. Y.

WASHABLE FABRIC—Which permits the production of a number of attractive designs with shadow effects on a special arrangement of white back ground, setting off the pattern. Patent 1660244. A. H. Vandam, c/o Turner & Vandam Co., 66 Worth St., New York, N. Y.

ROASTER—Of simple construction, effective for roasting and for boiling foods at the same time, easily cleaned, and readily accessible for observing the cooking progress. Patent 1660226. Ruth R. Heffner, 1065 McCane St., Brockway, Pa.

WINDOW GUARD—Adjustable to fit various sized windows, may be collapsed into small compass when not in use, and provided with means for preventing unauthorized removal. Patent 1660236. T. C. Rush, c/o Simplex Window Guard Co., Suite 208, Ingels Bldg., 144 Market St., Lexington, Ky.

COFFEE BIN—An ornamental receptacle especially adapted for use in retail stores, which displays the coffee and permits the convenient removal of any desired quantity. Patent 1660284. J. M. Waters, c/o Great Atlantic & Pacific Tea Co., Graybar Bldg., 43rd St. & Lexington Ave., New York, N. Y.

SCREEN ATTACHMENT FOR WINDOWS—Which may be detachably applied to the transverse rail of a sash, and raised or lowered with the opening or closing of the window. Patent 1660225. A. Haftel, 322 E. 8th St., New York, N. Y.

THEATRE STRUCTURE—Wherein a cantilever structure through the medium of brackets on the beams beneath the seating supports the mezzanines, and eliminates supporting posts. Patent 1660263. C. E. Fowler, c/o Fowler Engineering Co., 25 Church St., New York, N. Y.

CIGAR-ASH RETAINER—A cylindrical metallic-mesh cage for receiving the cigar while being smoked, and for retaining the ash, eliminating fire hazard and the chance of burned clothing. Patent 1661035. A. E. Falkenburg, 40 Saunders St., Whitehall, N. Y.

CALENDAR—Of the "perpetual" type, usable over a period of years by adjusting the elements which bear indicia relating to years, months and days. Patent 1661110. J. D. Cox, 1652 E. 38th St., Brooklyn, N. Y.

DOLL—Which is moved mechanically to oscillate vertically at the waist line, thus producing rhythmic movements closely simulating the movements of a hula dancer. Patent 1661093. G. D. Rogers, 28 Quent Ave., Allston, Mass.

BOTTLE CLOSURE—The construction being of such nature that the closure may be readily secured to or removed from a bottle or other receptacle. Patent 1661126. F. Maier, 231 Miles St., Elizabeth, N. J.

DOLL'S EYES—Arranged to produce movements after the manner of the human eye, the eyeballs turning from side to side and the eyelids closing as in sleep. Patent 1661094. I. A. Rommer, 273 Van Sinderen Ave., Brooklyn, N. Y.

GRAPEFRUIT SHIELD—In the nature of a hood for attachment to halved grapefruit or other citrus fruit for preventing spattering of the juice when eating. Patent 1661036. J. Fallek, 481 Eastern Parkway, Brooklyn, N. Y.

LINE TIGHTENER—So arranged that the tightening of a line may be effected by pulling the running end of it, without manually swinging the lever. Patent 1661045. F. J. Lee, 545 Graham Ave., Brooklyn, N. Y.

AEROSTATIC SIGN—In which the letters or characters are each individual balloons, themselves providing the means for holding the sign characters in reading relation. Patent 1658275. L. H. Wright, 132 No. Vandome St., Los Angeles, Calif.

ARTICLE RACK—A combined umbrella and overshoe rack for supporting and concealing articles of this type, whereby drying and draining the same is facilitated. Patent 1661098. S. R. Side, 1516 54th St., Brooklyn, N. Y.

COMBINED GRAPHOPHONE REPRODUCER AND RADIORECEIVER—A single unit embodying the sound amplifying means of any conventional graphophone as a loud speaker for radio receiving sets. Patent 1659128. R. W. Arnett, 2315 W. 75th St., Los Angeles, Calif.

Hardware and Tools

UNDERREAMER—Wherein a plurality of reamer blades are so constructed and organized that they are firmly supported in operative position with their shanks protected against wear. Patent 1659514. C. H. Brown, c/o Brown Tool Works, Breckenridge, Tex.

BOLT AND SCREW CLIP—Made from yieldable material for locking a bolt or screw against retrograde rotation, so that vibration of the body will not cause loosening. Patent 1660262. J. H. Fahey, 239 First St., Pittsfield, Mass.

WRENCH—Having locking means for releasably holding the socket members against accidental displacement, and protected against external objects that might cause injury. Patent 1660989. E. R. Carpenter, Ansonville, N. C.

KEYLESS LOCK—Designed as a lock for trunks, including a bolt-releasing mechanism subject to practically unlimited variations, thereby insuring the user against duplication of the combination. Patent 1654440. A. T. Warren, c/o Fred'k T. Warren, Quincy House, Boston, Mass.

SILENT CHAIN—Which reduces friction to a minimum, and in which the lengthening or stretching due to wear in the joints shall be negligible. Patent 1661074. C. E. Johnson and J. F. McCann, c/o The Pratt Chuck Co., Frankfurt, N. Y.

Heating and Lighting

GAS-IGNITING DEVICE—Simulating an automatic pistol, the sparking action being arranged within the interior of the barrel and actuated by pulling the trigger. Patent 1660277. K. Schreer, c/o M. E. Bernhardt Co., 127 W. 30th St., New York, N. Y.

Machines and Mechanical Devices

CENTRIFUGAL SUCKING AND FORCING PUMP—Characterized by valves at the bottom of each plunger causing the liquid to flow radially from the center to the periphery both in suction and ejection. Patent 1658705. G. Caproni, c/o L. Labocetta, Via Due Marcelli 31, Rome, Italy.

CHEESE SLICER—For cutting loaf cheese, the cutting means being in the form of a series of wires relieved of strain, all impact being received by rigid parts. Patent 1658675. C. F. Frank, 318 Cornelia St., Brooklyn, N. Y.

PENCIL-VENDING MACHINE—Controlled by a single rotary normally locked shaft which is released by the coin and in turn ejects the pencils one at a time. Patent 1657694. C. E. Parker, c/o Parker Pencil Co., Chamber of Commerce Bldg., Los Angeles, Calif.

PNEUMATIC GREASE GUN—For forcing lubricating grease into the bearings of engines and other machinery, more particularly the injection of very hard grease by high pressure. Patent 1657810. C. G. Cooper and A. J. Dinkel, Box 594, Yuma, Arizona.

DOUGH-MOLDING DEVICE—A machine which simulates the hand operation of flattening the dough coiling it into a roll and causing the layers of the coil to adhere. Patent 1658864. E. J. Sternberg, 4510 Addison St., Chicago, Ill.

DRILLING APPLIANCE—Which precludes the possibility of drilling a crooked hole, and facilitates and insures the drilling of a true straight well hole of uniform cross section. Patent 1659327. G. A. Montgomery, Box 2293, Dallas, Tex.

GRINDING MILL—Which aims to improve the usual mill in respect to efficiency, also prolong the life of its grinding parts and reduce the cost of upkeep. Patent 1659499. J. B. Sedberry, c/o Bossert Corp., Utica, N. Y.

SPINACH CLEANER—A receptacle having a controlled drain outlet which permits the easy and rapid removal of all dirt and grit, producing a perfectly clean food. Patent 1659473. M. Rein, 155 Hart St., Brooklyn, N. Y.

LAUNDRY-MACHINE-LOCKING MECHANISM—A safeguard, which makes it necessary for the operation of the machine to cease before the door of the outer cylinder can be opened. Patent 1659474. J. H. Siemann, 283 11th St., Brooklyn, N. Y.

FLUID-SHUT-OFF DEVICE—A safety fusible link which may be operated at any time manually, or by a cable at a distance, in addition to an automatic operation. Patent 1659518. N. B. Creighton, c/o A. H. Stines, 300 Grand Ave., Maspeth, N. Y.

MACHINE FOR SPINNING ARTIFICIAL SILK—So arranged that in addition to the spinning it produces a circulation of fresh air carrying away the gases harmful to the workmen. Patent 1659483. G. Donagemma, P. Tolini, M. Valentini, and E. Micozzi, c/o Leuzie & Co., 201 Via Tritone, Rome, Italy.

PUMP PACKING—In which the stuffing boxes for the driven pistons are located exteriorly of the pump, whereby the same may be readily removed or repaired. Patent 1660302. J. L. Shafer, Box 65, Joplin, Mo.

ACTUATING MECHANISM FOR SPINNING AND TWISTING MACHINES—In which the main driving pinions are so arranged as to co-operate with special intermediate pinions whereby both sides may be driven at unvariable speed. Patent 1661146. J. J. Keyser, c/o G. Hirschfeld, Alexanderstrasse 134, Berlin S. W., Germany.

SINGLE-LOADING FIREARM—With mechanism which guides the cartridge into the chamber at the close of the breach, providing for easier and quicker loading of the gun. Patent 1660282. R. von Frommer, c/o F. Schon, VII Erzsebet-Korut 19, Budapest, Hungary.

COUNTER PENCIL—Having a rotatable "scaling" element for indicating the total length of lines traversed and number of check marks made therewith at any particular time. Patent 1659901. A. T. Winquist, 1615 Morgan St., Aberdeen, Wash.

IRONING MACHINE—By means of which both ironing and pressing may be readily accomplished, easily manipulated, and capable of heating by gas, electricity or steam. Patent 1660622. E. H. McCurdy, 1787 Lafayette St., Pasadena, Calif.

BULL HITCH—Which may be applied to a projecting section of a pipe line of an oil well for gripping and raising the same by an elevator. Patent 1660258. T. Cushing, 205 E. 8th St., Bristow, Okla.

BRAKE BAND AND LINING THEREFOR—Wherein the lining may be applied to or removed from the band without the necessity of the band and operating mechanism being disassembled. Patent 1661057. W. B. Terry, 374 Williams Ave., Salt Lake City, Utah.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE—In which gaseous fuel is admitted directly to the combustion end of the cylinder through relatively large ports, operating to increase power and complete scavenging. Patent 1657399. D. M. Hughes, 2907 Knox Ave., Los Angeles, Calif.

LINING-UP REAMER FOR CONNECTING RODS—Wherein a plurality of set screws are positioned to engage and hold the connecting rod rigidly in a given position while the reamer is working. Patent 1659495. J. Nelson, 334 W. 84th St., New York, N. Y.

GAS ENGINE—Having an easily applied attachment for the breathing tube, whereby gases may be expelled at a point where grease will not be deposited upon the engine. Patent 1659500. V. N. Sevier and J. O. Hayes, Box 193, Dinuba, Calif.

DRAIN VALVE—For locomotive cylinders and elsewhere, in which the valve may be operated to effectively seal the cylinder against leakage of steam or entrance of air. Patent 1659126. J. D. Van Atta, c/o General Delivery, Yermo, Calif.

Railways and Their Accessories

AUTOMATIC PRESSURE RETAINING AND SUSTAINING VALVE FOR AIR-BRAKE SYSTEMS—Including a valve casing, and a core therein operable by variations in pressure in the auxiliary reservoir, upon the opposite ends of the core. Patent 1658678. W. B. Heiniger, 207 Edge Ave., Jersey City, N. J.

AUTOMATIC SLACK ADJUSTER FOR AIR BRAKES—Which will take up slack and make adjustments in the connections of the system for permitting proper application of the shoe for braking action. Patent 1661032. W. S. De Camp, 166 Race St., Chillicothe, Ohio.

BLEEDER VALVE—Which automatically empties the air brake air cylinders of railroad cars of air and water, and lubricates the cylinder. Patent 1661046. J. J. Miller, 332 No. Mears St., Chadron, Neb.

Pertaining to Recreation

GOLF APPARATUS—Which will so control a ball hit in the regular manner that the strokes may be played indoors, and true values of distance and direction estimated. Patent 1657913. E. L. Barnett, 149 Lexington Ave., New York, N. Y.

CONVERTIBLE VEHICLE—For children's use, which may be quickly and easily changed to either roll on wheels or slide on runners, and foot-pedaled in either form. Patent 1659517. F. Cornil, 533 E. Main St., Owosso, Mich.

KITE—Which in addition to providing a steady flying kite, allows for knocking down and rolling up for storage or transportation without disassembling the elements. Patent 1658006. F. Owens, 43 West Front St., Keyport, N. J.

JUMPING-FIGURE TOY—Having means for causing the same to adhere for a limited period to a support, and means for projecting the figure from the supporting surface. Patent 1657936. M. E. Nebel, 115 bis Rue de la Tour, Paris, France.

Pertaining to Vehicles

NON-PUNCTURABLE AUTOMOBILE WHEEL—Of the semi-pneumatic type, comprising a solid center section, a stiff outer section, and pneumatic intermediate members, the pneumatic feature, if injured, acting to form a solid. Patent 1657946. M. W. Wallace, 600 12th St., Rock Island, Ill.

SAFETY VEHICLE BODY—Which is substantially puncture-proof, fireproof, and watertight, provided with ventilating means for supplying the body with fresh air when the doors and portholes are closed. Patent 1657614. S. M. Code, General Delivery, Chicago, Ill.

AUTOMOBILE AIR BRAKE—With means for maintaining a reserve supply of air, whereby air may be taken to inflate tires under greater pressure than for the brake system. Patent 1657929. H. H. Inge and R. A. Smith, 104 W. 86th St., New York, N. Y.

REAR SHOCK ABSORBER FOR MOTOR VEHICLES—Which serves to limit the relative oscillations of the vehicle frame and rear axle in the vertical and also in the transverse direction. Patent 1658657. C. Schaeffer, c/o C. Blotry, Aine, 2 Boulevard de Strasbourg, Paris, France.

VALVE TOOL—By means of which a valve spring may be removed and another applied, without interfering with the valve adjustment, particularly adapted for Buick cars. Patent 1659523. R. R. Farrell and W. Lehnhoff, 1009 Montgomery St., San Luis Obispo, Calif.

PARKING WHEEL FOR AUTOMOBILES—An auxiliary device easily secured to the vehicle, whereby the front wheels may be rolled laterally in and out of parking position against curb. Patent 1658297. J. Myers, c/o Office of County Clerk, Oroville, Calif.

CONTROLLING SWITCH—Whereby the operator of a vehicle may unmistakably signal to drivers of other vehicles his intention to slow down, stop, or make a turn. Patent 1653517. S. L. Smith, 315 W. 97th St., New York, N. Y.

VEHICLE SPRING CONSTRUCTION—In which pressure is equalized on all the springs in all directions of movement, which obviates shock absorbers, and may be well lubricated. Patent 1659798. J. E. Wood, c/o W. A. Scott, 10,329 Prospect Ave., Chicago, Ill.

AUTOMOBILE BED CONSTRUCTION—In which the seats and cushions of the ordinary car may be utilized with comparatively little change, to make them readily adaptable to the invention. Patent 1659887. W. W. McLean, 750 So. State St., Elgin, Ill.

MOLD—In which a tire or shoe can be securely held and a new tread of the desired contour or ornamentation fused thereto. Patent 1660653. E. Nestler, c/o Nestler Rubber Fusing Co., 245 West 55th St., New York, N. Y.

INTERNAL-EXPANDING BRAKE—For motor vehicles, in which the band is expanded uniformly thereby effecting maximum braking action with minimum effort and a uniform wearing of the liner. Patent 1658288. E. A. Hardison, 1416 Kallam Ave., Los Angeles, Calif.

HYDRAULIC BRAKE FOR VEHICLES—Wherein means are provided for maintaining the supply of liquid while automatically discharging any air that may become mixed with the liquid. Patent 1661029. G. B. Boyd, 115 Front St., Dunellen, N. J.

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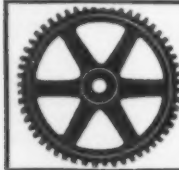
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